

The background of the cover is a collage of various electronic equipment. At the top right, there's a close-up of a control panel with a meter and several knobs. Below it, a larger piece of equipment with a digital display and many buttons is visible. On the left side, there's a rack of several smaller electronic modules. In the bottom left, a stack of three units is shown, with the top one having a screen. The overall theme is technical and related to radio communication equipment.

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November 1999

13th Anniversary installation and maintenance issue

On the cover: Previously owned analytical instruments offer small shops an affordable path to upgrades. See the cover story on page 20. Cover design by Scott Dolash, art director. Photographs courtesy of RF Imaging and Communications.

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Scanning . . .

The little company that grew

Time was when Nextel Communications wanted to convert specialized mobile radio (SMR) spectrum to wireless telephone service.

Many small business operators saw SMR spectrum as theirs to use to serve two-way radio dispatch customers, including those customers that wanted limited telephone interconnect. Nextel found a way to obtain such a large number of licenses throughout the country that many SMR operators were blocked from expanding their channel assignments. There were plenty of SMR operators willing to sell their systems to the company when it was paying lots of dollars—maybe top dollar.

The company then found a way to buy at auction much of the remaining SMR spectrum and gained government approval to relocate incumbent SMRs within the band. That process doesn't seem to be moving rapidly, for a variety of reasons.

When Nextel saw an opportunity to buy licenses that had belonged to a defunct SMR, Geotek Communications, the company sought release from an agreement with the government that capped Nextel's acquisition of additional spectrum in certain cities. Whether that will happen isn't certain, but Nextel has been advancing its cause, step by step, with favorable decisions in the matter by the federal government.

The company found another possible way to increase its spectrum holdings when it cut one more deal with the government to allow it to acquire spectrum from NextWave, a PCS operator that defaulted on payment for spectrum won at an FCC auction.

However matters are resolved involving alleged abuse of the FCC licensing process by Nextel, and companies with which it subsequently merged, the company just may get past all of its spectrum woes if it obtains that PCS frequency band. And, in a way, maybe that will help to divert the company's attention from the SMR band. That could be a relief to incumbents faced with relocation problems. The time incumbents spend resolving legal, regulatory and technical matters is time they can't spend selling service to new customers.

And Nextel? It's doing fine, thanks. It's lost enormous sums of money while

its stock has soared. It bought back stock owned by its departing chairman, Dan Akerson, netting him a couple of hundred million dollars for a few years' work that took the stock from \$16 to \$70. Whatever you may think that Nextel's doing wrong, it does right by its executives (and others who bought the stock low and sold high; there *have* been opportunities with Nextel stock to



do the reverse.)

Events are moving so fast for the company that the days of spectrum warehousing at 800MHz could seem only a distant memory (or nightmare) if it weren't for the fact that small SMR operators still face channel expansion problems.

Kaiser Permanente

"Hello? Kaiser Permanente? May I have an ambulance, please? Pretty please?"

One of the nation's largest health maintenance organizations, Kaiser Permanente, sent identification cards to its members that include language that might require its members to first call

Kaiser's toll-free number to report potential medical emergencies—not 9-1-1. That alarms the Association of Public-Safety Communications Officials, International (APCO) and the National Emergency Number Association (NENA), among others. They see it as an attempt to divert emergency calls from the 9-1-1 system to manage health care costs.

There are huge flaws with this national toll-free call center idea. The system might have caller ID, that may or may not work, but it won't have the details that 9-1-1 databases provide. The national call center would have tremendous difficulty rerouting the call to the appropriate agency. Some callers might only be able to place one call before circumstances or a decline in their vital signs prevent additional dialing. The possibly more useful follow-up call to 9-1-1 might never happen.

Will Kaiser Permanente clear up the confusion by mailing millions of replacement insurance cards that do not recommend its call center in lieu of 9-1-1? Oh, that costs money.

A second opinion: "Society has all but destroyed the 9-1-1 system. It is now a speed-dial to the cops. People call and ask for the correct time or road conditions," according to a Denver police captain quoted in the September 1999 issue of *Dispatch Monthly* magazine. The story explained how 9-1-1 calls were delayed in that city on July 4 because of calls to report noisy fireworks.

We haven't tried Kaiser Permanente, but even so, we're inclined to prefer 9-1-1, even on the Fourth of July.

Don Bishop

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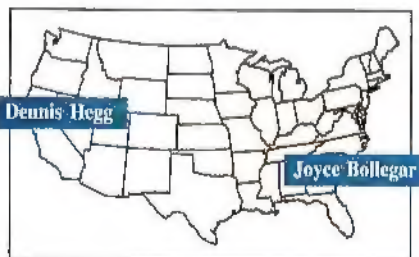
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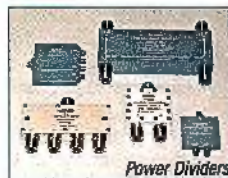
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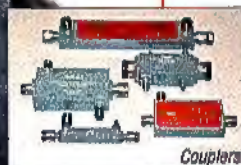
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1-4: Telecommunications Resellers Association Fall Conference and Exposition, sponsored by TRA, Dallas. Contact: 202-835-9898 or Web site www.tra.org.

2-4: Wireless I.T., sponsored by the Cellular Telecommunications Industry Association, Santa Clara Convention Center, Silicon Valley, CA. Contact: 202-785-2842 or Web site www.wow-com.com.

8-9: ENTELEC & UTC Joint Fall Seminar, JW Marriott, Houston. Contact: 888-503-8700 or email entelec@pdq.net.

10-14: Communications Marketing Conference, sponsored by the Communications Marketing Association, Harvey Hotel, Dallas. Contact: Jack Armstrong, 410-308-0808.

15-16: AMTEX, sponsored by the American Mobile Telecommunications Association, Hilton, Walt Disney World Village, Lake Buena Vista, FL. Contact: 202-331-7773 or Web site www.amtausa.org.

15-16: Fourth International Congress on Commercial Trunked Radio, sponsored by the International Mobile Telecommunications Association, Hilton, Walt Disney World Village, Lake Buena Vista, FL. Contact: 202-331-7773.

16-17: Advanced RF Safety Training, sponsored by RF Emission Measurements, Southlake, TX. Contact: 817-312-5363.

17-19: TelecomLatina, co-sponsored by *Mobile Radio Technology*, Miami Beach Convention Center, Miami. Contact: 800-288-8606 or Web site www.telecomlatina.com.

19: Radio Club of America Communications Symposium, 91st Anniversary Dinner and Awards Presentation, New York Athletic Club, New York. Contact: Geri Hopkins, 732-842-5070.

2000

February

15-18: APCO Gulf Coast Regional, sponsored by the Association of Public-Safety Communications Officials-International, Corpus Christi Omni Bayfront, Corpus Christi, TX. Contact: Toni Dunne, 512-305-6918 or Web site www.apcointl.org.

15-18: N.A.T.E., sponsored by the National Association of Tower Erectors, San Diego. Contact: 888-882-5865 or Web site www.natehome.com.

28-March 1: Wireless, sponsored by the Cellular Telecommunications Industry Association, Ernest Morial Convention Center, New Orleans. Contact: 202-785-0081 or Web site www.wow-com.com.

March

6-8: APCO Western States Regional, sponsored by the Association of Public-Safety Communications Officials-International, Doubletree Hotel Portland, Portland, OR. Contact: RoxAnn Brown, 503-690-4911 ext. 206 or Web site www.apcointl.org.

19-22: ENTELEC, sponsored by ENTELEC, Dallas Convention Center, Dallas. Contact: 281-357-8700 or Web site www.entelec.org.

22-24: International Wireless Communications Expo, co-sponsored by *Mobile Radio Technology*, Las Vegas Convention Center, Las Vegas. Contact: 800-288-8606.

April

10-12: APCO North Central Regional, sponsored by the Association of Public-Safety Communications Officials-International, Holiday Inn, Worthington, OH. Contact: Jay Somerville,

614-761-6530 or Web site www.apcointl.org.

May

8-11: Telecommunications Resellers Association Spring Conference and Exposition, Philadelphia Marriott. Contact: 202-835-9898 or Web site www.tra.org.

15-18: Spring Vehicular Technology Conference, sponsored by IEEE Vehicular Technology Society, Hotel Pacific Tokyo, Tokyo. Contact: 81-468-40-3552 or email matumoto@mars.yrp.nttdocomo.co.jp.

30-June 1: Canadian Wireless, sponsored by the Canadian Wireless Telecommunications Association, Toronto, Canada. Contact: 613-233-4888, ext. 102, or Web site www.cwta.ca.

June

4-8: Supercomm, sponsored by TIA and USTA, Georgia World Congress Center, Atlanta. Contact: 800-278-7372.

25-29: UTC Telecom, sponsored by UTC, The United Telecom Council, Phoenix. Contact: 202-857-1881 or Web site www.utc.org.

August

13-17: Association of Public-Safety Communications Officials-International (APCO) National Conference, Boston. Contact: 904-322-2500 or Web site www.apcointl.org.

September

19-22: Fall Vehicular Technology Conference, sponsored by IEEE Vehicular Technology Society, Seaport Hotel, Boston. Contact: 904-322-2500

26-29: Personal Communications Showcase, sponsored by PCIA, McCormick Place, Chicago. Contact: 703-739-0300 or www.pcs00.com.

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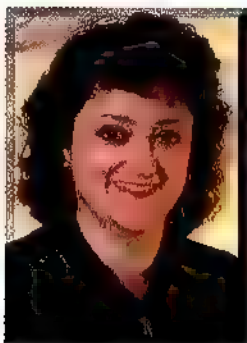


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On the threshold

With the next issue of MRT dedicated to our annual Buyers' Guide—and with the new millennium lurking around the corner—now is the time to gaze into the proverbial crystal ball and play soothsayer!

I'm going to pass, though. Playing the role of prophet in an industry that is evolving as fast as this one is just too daunting of a task. It's more fun to sit back, listen to the promises and forecasts made by industry leaders, experts and pundits, and throw them

out for you to ponder. In other words, I'll play the reporter and you can make your own predictions. Consider these facts as you prophesy about the upcoming century

□ What can we learn from the "love match" between industry giants MCI Worldcom and Sprint? Yes, it's news from that "other part" of the wireless market, but any significant advancement made by cellular and PCS ranks affects the efforts of the land mobile industry. The near-\$130 billion price tag seems ridiculous, considering that the entire international wireless industry's gross revenue in 1998 was just approaching \$200 billion. The U.S. cellular/PCS annual revenue alone was around \$39 billion in '98. Is this indeed a "perfect marriage" that will result in a powerful, innovative service-oriented mega-company? Is it a wake-up call to the FCC to preserve healthy competition? Or, is it a forewarning to the consumer of fewer options and higher rates?

□ And then there is the promise made by FCC Chairman William Kennard that the commission's new strategic plan, "A New FCC for the 21st Century," will help bring about a new FCC. According to Kennard, the FCC is reinventing itself to keep pace with the "rapidly changing communications industry landscape." He added that by following this plan, the FCC will be able to respond fully and quickly to emerging technologies and increased convergence, as well as "the inexorable movement from regulation to competition." Within five years, the FCC's vision is to restructure the agency into the functional areas of enforcement, consumer information, licensing, competition/policy and international communications. Just think, a new FCC along with the new millennium. What will they think of next?

The issues of spectrum, regulation and efficient technologies have preoccupied us during the '90s. What will we face in the new decade? Email us at mrt@intertec.com with your opinions, and we'll post them on the Web at www.mrtmag.com.

—Ramona Isbell

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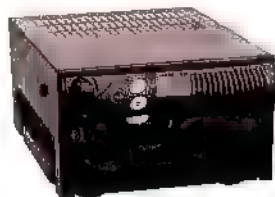
MODEL SS-25M



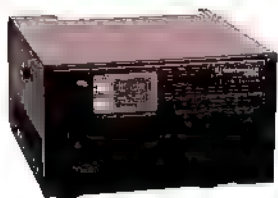
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MODEL	CONT. (Amps)	ICS	SIZE (Inches)	Wt. (lbs.)
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SS-30M*	25	30	3 1/4 x 7 x 9 1/4	5.0

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MODEL	CONT. (Amps)	ICS	SIZE (Inches)	Wt. (lbs.)
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SRM-30	25	30	3 1/4 x 19 x 9 1/4	7.0

WITH SEPARATE VOLT & AMP METERS

MODEL	CONT. (Amps)	ICS	SIZE (Inches)	Wt. (lbs.)
SRM-25	20	25	3 1/4 x 19 x 9 1/4	6.5
SRM-30	25	30	3 1/4 x 19 x 9 1/4	7.0

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MODEL	CONT. (Amps)	ICS	SIZE (Inches)	Wt. (lbs.)
SRM-25A-2	20	25	3 1/4 x 19 x 9 1/4	10.5
SRM-30A-2	25	30	3 1/4 x 19 x 9 1/4	11.0

WITH SEPARATE VOLT & AMP METERS

MODEL	CONT. (Amps)	ICS	SIZE (Inches)	Wt. (lbs.)
SRM-25M-2	20	25	3 1/4 x 19 x 9 1/4	10.5
SRM-30M-2	25	30	3 1/4 x 19 x 9 1/4	11.0

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Schools and communications

I spent 12 years in law enforcement and the last 27 years with Motorola and am now retired. I live in Jefferson County (CO) and, in fact, was raised here and also have three sons that are from this area. I enjoyed your article ("Elementary—Not Secondary," *Editorial Forum*, July 1999). Schools not only need to look at what they have done over the years and how they used a communications system, but what it was designed for and who was trained to use the system. Most school administrations are like a fire alarm—until it is used they forget what it is for or when to use it. The biggest problem in the Jefferson County tragedy was with the local communications systems. They could not talk to each other, and some agencies could not even talk to themselves. They had a lot of chiefs and no Indians. Over the years, standards have been talked about (Project 25 and others), and with all the money spent, there is still a problem. Frequencies should not be a problem. At this time, the challenge is understanding the problem, use of standards and working together to solve all this. It has not been solved over the last 30 years, and you and I will never see it solved today.

Over the years I have spent 90% of my time working with the government in the communications field, and the problem you talk about has been here all this time.

—Jan A. Burton
J-B Burton Enterprise
Denver

FCC forms too time-consuming

Years ago, I used to refer to people, or groups of people, who seemed to be out of control and making a mess of things, as "having run amuck." Last month, while attending the National Forestry Conservation Communications Association Conference, and reviewing the latest Form FCC 601, it occurred to me that someone out there "has run amuck."

The pile of papers that I was given at the conference was roughly 1/2" tall. In that pile of papers, it states that in order to modify a conventional two-way land mobile station license, I will need to fill out as many as 10 pages of forms and follow the rather lengthy instructions contained in the 1/2" tall pile of paper. In the "Notice

to Individuals Required by the Privacy Act of 1974" and "The Paperwork Reduction Act of 1995," which were included in the pile, the FCC indicates that the average time needed to prepare a response (application) was 1.25 hours. I have read most of the instructions, gathered required information and filled out many forms, but have as yet not been able to get my time down to less than two hours per application. It saddens me to think that I'm that much below average, at least according to the FCC.

Filling out a request to modify a conventional two-way land mobile station license used to be a fairly simple process and only required that we fill out a single sheet of paper. Now we are being told that the application process is to be computerized and that we will soon be able to file electronically. I hope the FCC will do a better job of keeping the process simple and minimizing the burden that is placed on the applicant than they have to date.

Some of the information they are asking for seems out of place and has little if anything, to do with frequency management. What does my race, ethnicity or gender have to do with spectrum management? If the FCC desires to collect additional information, it should consider collecting information that would be helpful, such as the frequencies that are used by receivers of two-way land mobile relays and duplex stations. Providing this information to the frequency coordinators could help enormously in avoiding interference problems.

When I speak with FCC representatives about my concerns, they tell me that it is required by law, which is handed down to them by our politicians. When you ask a politician why the law, they suggest it is because that is what the people want. For what it is worth, this "people" wants a simpler process that uses fewer resources and provides us with useful information. The present Form FCC 600 and the proposed Form FCC 601 do not fill the bill.

It appears that someone "has run amuck." Is it the FCC, our elected representatives, someone else, or all of the above?

—Everett John Alberts
Telecommunications supervisor,
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MOTOROLA

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It's never been easier to fill in your network

Message Center Management

Historically, during the days of Lewis and Clark, pioneers were brave explorers who faced daily hardships head-on along the Oregon Trail. These early trailblazers led the way for other settlers to follow. Although not too many uncharted territories are left to explore in the United States geographically, developing technology has brought a whole new breed of explorers and innovators to the foreground.

After nearly 40 years of developing, customizing and building wireless communications networks, Message Center Management (MCM) has earned recognition in the industry as a pioneer and an innovator. Since 1960, the company has provided timely business solutions, including network deployment of transmitting systems.

Today, the company continues to uphold its pioneering tradition via its growing lineup of professional services and simplified site installation. MCM offers a complete package of facilities and carrier services, coupled with a Web-accessible inventory of facilities. From site acquisition to installation, maintenance and management, MCM focuses on customizing its service offerings.

A rich history

Based in the heart of the Northeast in Hartford, CT, privately held MCM embodies the pioneer spirit that drives the wireless industry. Initially, MCM evolved from wireless network construction. Its founders and president were one of the first land mobile license holders in the wireless industry. As a license holder of paging and SMR frequencies, the company built a network from Maine to Florida, and in the early 1990s, went on to build and launch one of the first nationwide paging networks in North America.

As MCM progressed, it continued to strive to meet customer requests. It was this basic business practice that quickly led to MCM's thriving business of site management.

"Over the years and throughout these builds, property owners began to ask if we could manage their rooftops, towers, water tanks and other structures and bring on other wireless carriers," said Maria Scotti, MCM's director. "Hence, the inception of Message Center Management."

Facilities services and management

Management of site facilities, tower, rooftop space rental, site selection/acquisition and regulatory zoning consultation are MCM's core services. The scope of the company's management offerings include:

□ **Controlled rooftop access:** MCM has identified safety as its highest priority. "We will make sure the site installation is safe and secure, and provide whatever measures are necessary to restrict site access to unauthorized public and personnel," said Scotti.

□ **Compliance with all local, state and federal regulations:** Local permitting and zoning regulations varies from region to region. MCM relies on its staff's experience to understand local ordinances to make sure its clients are in full compliance. Depending on the nature of the installation, FAA laws may also need to be considered.

□ **No radio frequency interference:** In 1996, the FCC set stringent law and complex regulations prohibiting RF interference. MCM believes that its expertise in this area is a critical ally to its clients to assure that rooftop tenants comply with all FCC regulations. MCM takes specific measures to guard against interference with existing systems

in a building. For rooftops with multiple transmitters, MCM's goal is to prevent transmitter-to-transmitter "intermodulation" interference.

□ **Site management for maximum business potential:** "We have relationships with the industry's largest wireless service providers, allowing not only the ability to effectively manage carrier-owned facilities, but to maximize co-location opportunities" Scotti said.

□ **Professional site management:** The MCM staff includes professionals in site leasing, site acquisition, construction, engineering and contract administration. The company will continue to focus, Scotti said, on offering customers a courteous, professional relationship with a "single-phone call solution" to any issue that may arise.

Servicing the carriers

Continuing development of wireless telecommunications services and the proliferation of alternative local service providers, coupled with the demand for more communications services, have created a business opportunity where once there was none. Today's carriers, realizing this potential, turn to MCM for guidance in the following areas:

□ **Site acquisition and management:** Carriers rely on MCM's quick site locator service and inventory listings to assist them with eliminating coverage gaps and filling in networks. If a location is outside the company's inventory, MCM's site acquisition services are available to help carriers locate the right sites for their needs. MCM continuously expands its inventory listings. A complete listing can be found on the site locator section of MCM's most recently redesigned Web site at www.mcmgmt.com. The QuickSite Locator provides quick access to the company's inventory of rooftops, water tanks, towers and other structures through the country.

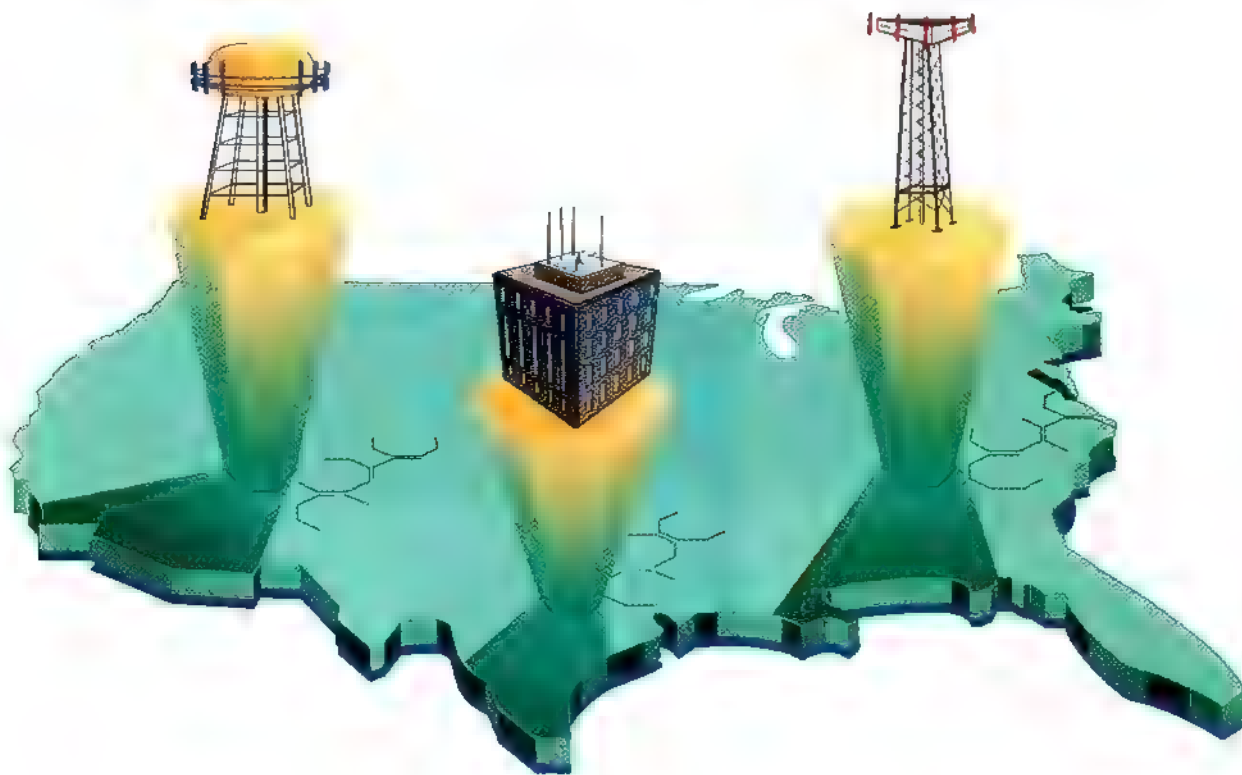
□ **Site installation, maintenance and security:** Acting as the construction manager of the site installation and maintenance, MCM can oversee zoning issues, prepare engineering and architectural studies, coordinate local utility services and provide routine maintenance. MCM will supervise equipment installation and ensure property integrity. And, as a final assurance, MCM maintains stringent procedures and systems at all of its facilities to keep its customers' equipment safe.

□ **Site intermodulation and RF emissions studies:** MCM reviews all tenant equipment specifications and required RF filters to assure maximum co-location use. New equipment will not be added to the site until all factors have been analyzed and approved. MCM provides intermodulation, RF emissions control, OET-65 compliance, FCC/FAA compliance and inventory control on all of its sites.



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Circle (13) on Fast Fact Card

Mexican standoff

By Robert H. Schwaninger Jr.

If you've ever had the FCC inspect one of your facilities, you know what it's like to have the federales come callin'. It usually begins with a telephone call from an FCC field agent who tells you that they will meet you at your site in a few hours.

"Please have copies of your licenses and your station logs ready for our review," the syrupy voice states with faux politeness.

You, of course, drop what you're doing and rush to the filing cabinet, where you're sure the licenses have been neatly filed. Rifling through the copies, you notice that one of your licenses is missing, and another one doesn't list the right coordinates. Ah—no—that's the one you meant to re-new last month.

"What's the expiration date?" you ask aloud of no one in particular. "Darn it! How many mobiles does that say? No! NO! This isn't fair. ... I know—I'll tell them that my old office manager died and took the records with her. Yeah! No—wait! That's no good. 'My dog ate it'? No good. Uh, uh, 'The ERP's so high because I don't know a gain antenna from a granola bar'? Holy moley, this ain't going well already, and they're not even here yet."

A couple of dozen operators enjoyed this thrill last year when the FCC sent inspectors around the Denver area to see how people were using that stuff called "spectrum." What the inspectors were after was evidence of stations that were providing commercial service on private-licensed channels. Did they find evidence? Yes. Did some operators get caught with their proverbial drawers around trembling ankles? Yes. Could this happen to you? Oh, yes.

Schwaninger, MRT's regulatory consultant, is the principal in the law firm of Schwaninger & Associates, Washington, which is counsel to Small Business in Telecommunications. Schwaninger is also a member of the Radio Club of America.

There are many signs that the FCC is beefing up its enforcement efforts across the board. New people have been hired to process complaints. The FCC's Gettysburg office now has enforcement folks in residence. Formal complaints against common carriers and cable TV licensees are actually being processed in less time than it takes to build a battleship out of Popsicle sticks.

So, what should you do? How about ... looking in the darn file drawer *before* the FCC inspects your

[section 90.179]), it would be really keen if your records reflected those sharing agreements. Without the deal committed to paper, it just falls apart. The FCC is going to figure that if the sharing licensees don't have a contract, then they aren't *sharing*. They're just getting commercial service from the two-way shop's repeater.

In general, the FCC is issuing more and more fines, notices of apparent liability (NALs), orders to show cause and letter inquiries under Section 308(b) of the Communications Act. Licensing with exactitude is being demanded, and failure to keep it current is resulting in fines paid for all transgressions. For example, a local government was fined a few thousand dollars for letting its special temporary authorization (STA) lapse for seven days. Think *zero* tolerance—and get it together.

Bordering on madness

Of course, no matter how well you prepare yourself, "no one" expects the Spanish Inquisition." That is, no one expects a call from the U.S. Department of State. One operator, Kwik-Page Communications, Los Angeles, got such a call.

Kwik-Page is licensed to operate a number of 931MHz paging facilities along the West Coast, with a system that stretches from Southern California to Washington on 931.6625MHz. Three of its licensed facilities serve the San Diego area. Unfortunately, the FCC's database only showed *one* of the licenses when the FCC en-

tered into an agreement, called a *protocol*, with the Secretaria de Comunicaciones y Transportes of the United Mexican States to decide how this spectrum would be used within 120km of the border.

When the protocol was announced, the FCC did grandfather the use of all licensed facilities using the channels on the U.S. side of the border. So, the one facility *shown* as licensed to Kwik Page was allowed to continue to operate,



"Canus
Excusare
Absurdus."

Illustration by John Hayes

facilities? What a concept! You would be surprised at the change in attitude the FCC has when you keep your licensing up to speed so that there is some quaint resemblance between the technical parameters on your license and the equipment you are operating.

As for shared facilities (those that are used by more than one private radio licensee and that operate on private spectrum in accord with 47 CFR Part 90 rules

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What about the other two transmitters? Well, according to the State Department, they're not supposed to be operating.

Now we've got a problem that is more exciting than trying to explain to a diplomat what power flux density is. The Mexican government wants the U.S. government to honor the protocol (translation: get Kwik-Page off the frequency). However, Kwik-Page has licenses for its two non-grandfathered stations. The Mexican operators are complaining about interference from Kwik-Page's system. The Communications Act does not allow the FCC to can-

cel licenses without a hearing and other due process protections. The local San Diego FCC field agent is pulling his hair out trying to find a technical solution. The Wireless Telecommunications Bureau is trying to figure out a solution. The State Department is trying to avoid appearing stupid to the Mexican government. The Mexican government is getting heat from its licensees, who thought the channel would be clean near the border. And Kwik-Page... is trying to serve its customers.

Kwik-Page is getting fed up with the constant assault on its operations by the FCC, the Mexican government

and the State Department. It has tried to accommodate the FCC by configuring one of its stations to direct the signal north, but the efforts have not netted the beleaguered operator any good will. Instead, Kwik-Page is being invited to round after round of discussions to address the problem, even though the solution is simple.

The FCC should simply: (1) admit that it made a mistake in failing to list two facilities in its grandfathering language within the protocol; (2) amend the protocol to protect its licensees' lawful use of the spectrum; (3) provide Kwik-Page with its rights as a commission licensee; (4) respect due process; and (5) stop trying to make Kwik-Page provide the solution to the FCC's own mistake. This method of "We blew it, you fix it" is

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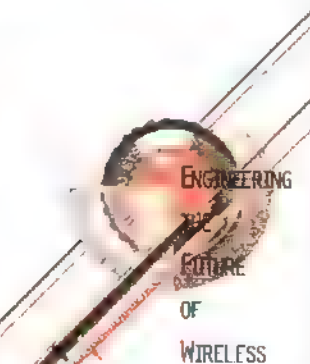
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The FCC also entered into the protocol without public notice or even individual notice to affected licensees. If the agency had asked ...

just not working.

The Kwik Page situation is not wholly unique. My sources tell me that the FCC has similarly messed up with other 900MHz paging licensees along the border. Are these other licensees playing along, or digging in?

It's a long road that has no turning

Here's the irony: The FCC itself clearly states in its auction orders that persons using the FCC database should recognize that the FCC does not warrant the accuracy of the information contained therein, which may, indeed, be incomplete or simply wrong. So, the FCC cannot say it wasn't warned. The FCC also entered into the protocol without public notice or even individual notice to affected licensees. If the agency had asked the licensees affected, it would have been told about errors in the database.

Guessing how this one is going to turn out is kinda' fun. It's as though the affected licensees asked the FCC to show them the agency's station logs for entering into the protocol, and the agency is rifling through its file drawers, saying "We'll just tell the Mexicans that our dog ate it. No, wait! That won't work! How about"

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Circle (16) on Fast Fact Card

Exploring experienced equipment

For small- to mid-size benchtop operations, a pre-driven piece of test equipment may be financially attractive.

By Matthew Halverson

"Out with the old, and in with the new." It's a time-honored cliché, and one that more than a few people adhere to. There is a certain thrill to buying a new car, a new home or even a new suit that no one has ever driven, lived in or worn, respectively. As long as you don't default on the payments, it belongs to you. Buying 'used' is considered to be the less desirable second option for those who simply can't afford the luxury of a new item. However, in the world of RF test equipment, a few people would like to change the image of used items and show that it is possible to teach an old dog new tricks.

Test equipment is expensive. Spectrum analyzers, oscilloscopes, radio service monitors and other such units can cost from \$20,000 to \$30,000. Although large corporations, like OEMs, have little trouble spending large sums on equipment, it is the smaller service center or maintenance shop, struggling to adhere to a budget, that has difficulty allocating money for expensive analytical devices. That's where the used

equipment dealers come in.

"Our main market is 'mom and-pop' middle-America," said Paul Zeppa, president of RF Imaging and Communications, Martinez, CA. "Price is the number-one reason these smaller companies buy used. These guys can get a unit that is option-rich for 70% of the

'If it wasn't for price, everyone would be buying new.'

—Bowman

original cost."

However, a 30% discount is not necessarily the rule. Steve Noll, a test and manufacturing engineer for Advanced Photonix, Camerillo, CA, and who also operates a Web site devoted to used test equipment dealers (www.big-list.com), pointed out that there can be a 5:1 price difference between two identical units sold by two different dealers. "It definitely pays to shop around," he said.

Rick Bowman, owner of Amtronix Instruments, Lakewood, NY, said several factors enter into the pricing of used equipment: everything from the condition in which a unit comes to the dealer who refurbishes it, to the age of the

piece, can affect the used price. In the end, however, the most basic tenet—economics—is the deciding factor.

"Just like with any other product, supply and demand are the biggest things that determine the price," Bowman said. "If no one is buying it, the price is going to go down."

However, Bowman said the proliferation of cellular, paging and two-way radio over the last decade has greatly increased the demand for used equipment among smaller companies.

"The majority of our buyers are smaller to midsize companies," he said. "Price is no doubt the major factor. If it wasn't for price, everyone would buy new."

The growth of these communications sectors has stimulated a greater demand for used equipment, and it has also created a larger pool of equipment from which used equipment dealers can cull their resources. Both Zeppa and Bowman said they get a majority of the units they resell from larger companies that have either gone out of business or shut down a particular division.

"There has been a lot of action in the radio production and RF-related industries lately," Bowman said. "A lot of companies start up, buy new equipment, shut down after five years and then have to sell off that equipment."

Buyer be aware

Although purchasing used equipment

Halverson, an MRT intern, is a senior in the journalism school at the University of Wisconsin—Madison. His email address is mghalver@students.wisc.edu

Photos appearing on pages 20 and 21 were supplied courtesy of RF Imaging and Communications, Martinez, CA

is an attractive alternative to spending exorbitant sums on new units, Noll offered a few caveats to potential buyers.

"There are two things you definitely want from a used equipment dealer, and most offer them: a warranty of at least 90 days and a right of refusal of be-

cessories or system options, are not as important and can be dealt with on a case to case basis.

Aesthetics and dealer reputation

The *appearance* of the unit is something else to consider. Zeppa compared the sale of used equipment to the used car industry.

"It's got to look as good as it operates," he said. "If you take it out of the box and it doesn't look good, that creates a bad first impression. It might work perfectly, but if it doesn't look nice, that customer is cursing me every time he looks at the unit."

Bowman said going the extra mile to make an instrument look good is a small price to pay for

the customer satisfaction.

"Cosmetics are very important," he said. "These pieces are expensive enough that we can spend a little extra money to make them look good."

Dealers that do not go that extra mile (or the first few, for that matter) bring down the reputation of the rest of the industry, according to Zeppa.

"You've got a lot of guys in the business that are 'working off their kitchen table,' so to speak, selling for less and not backing up their merchandise," he said. "Luckily, they can't compete because they produce an inferior product."

Bowman had a similar assessment. "A lot of the big companies with lots of money buy new simply for the peace of mind. That's why when you buy used, you have to be cautious. A customer has to have faith in the calibration and the overall performance of the unit."

Complicating the used equipment buyer's assessment of a renovated device (and the workmanship that went into its restoration) is the lack of regulation in the used

equipment industry. Both Bowman and Zeppa said regulation could help, but questioned how effectively dealer practices could be controlled.

"There's no real way to regulate the industry because anyone can slap a calibration sticker on their product," Zeppa said. "The ability to offer those warranties and rights of refusal is what sets a reputable company apart from others because if you can't stand behind your product, you can't offer them."

Bowman pointed out other ways to combat the lack of regulation. "There are several new compliance standards for calibration," he said. "The Z540-1 set of compliances tells everything a lab has to do in order to be in compliance, and a lab can be audited by the government to make sure they are in compliance if they claim to be."

Untrustworthy dealers and lack of federal regulation aside, used test equipment offers a viable alternative to companies and agencies without the means to purchase a new instrument. It's fun to take that brand new product out of the box and realize that no one has ever used it before, but there's something to be said for the character and personality of a used item. ■



tween five to 10 days, during which you can return the unit, with no questions asked," he said.

RF Imaging offers a six month parts and labor warranty and a 10-day right of refusal. Amtronix offers a 90-day full warranty on parts and labor and a five-day right of refusal. Noll says both plans are well within the parameters for a reputable dealer.

Another important question to ask, according to Noll, is whether the instrument comes calibrated and whether the dealer can provide a certificate of calibration.

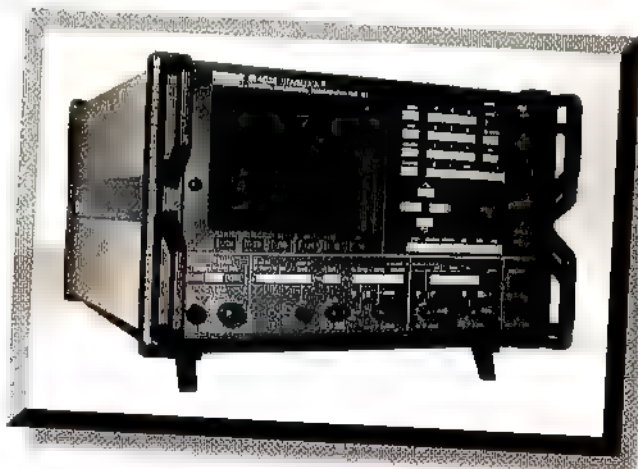
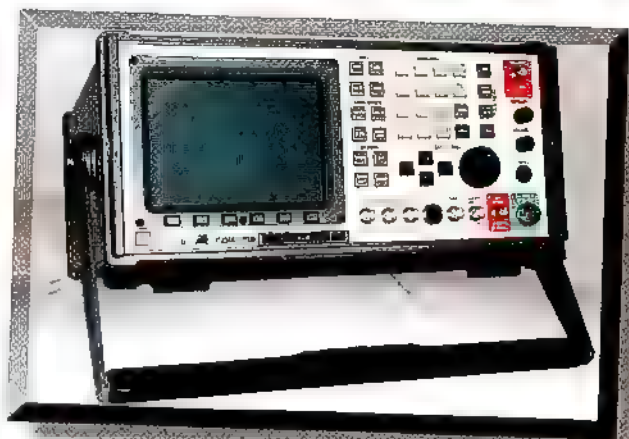
"There are probably a lot of dealers out there that don't calibrate their units before selling them," he said. "It costs a little more, maybe \$50, but it would be very wise to get that certificate of calibration."

According to Zeppa, you can never be too careful when asking about the calibration of equipment.

"I've gotten a lot of equipment, from the dealer network, that is supposedly calibrated, but it turns out not to be," he said. "I just go ahead and 'cal' everything, and everything is performance-tested."

Bowman said it is also important to research the *methods* of calibration. For example, an "NIST-traceable" calibration means that the dealer applied the standards of the National Institute of Standards and Technology. "In this case, you can get paperwork that shows the equipment has been calibrated to these standards," Bowman said.

Other considerations, such as the availability of an operator's manual, ac-





New hand-held analyzers make field testing easier and more convenient with their decreased size and combination of functions.

By Yuenie Lau

In the race to offer customers wireless services, carriers continue to add cell sites, both on the hills in the suburbs and on the rooftops of city buildings. Field technicians responsible for maintaining the performance of these cell sites have had to do more testing as a result of this commercial explosion, lugging so-called "portable" instruments to each location. New hand-held test instruments, however, are changing the way technicians look at signals and making analysis easier and less strenuous.

Carriers are expanding services by installing multichannel, multipoint distribution services (MMDS), local multipoint distribution services (LMDS) (currently known as BWA), wireless local area networks (WLAN) and other

point-to-multipoint sites throughout the country, some close to existing cellular, PCS and microwave base stations. Although these services operate at different frequencies, interference occurs often because of the growing number of tower sites. Field technicians are being dispatched to quickly determine the cause of such noise.

Determining if there is a fault, interference or a cell coverage problem at a site adds another task for a single technician, who may already be responsible for as many as 50 cell sites. Worse, the field technician, who receives less training than in the past, may still carry a spectrum analyzer and a vector network analyzer (VNA) to the site. Although both instruments are considered "portable," they are not lightweight—especially after the tenth stop. Most portable lab instruments are not user friendly by field standards and are tailored to a user who is willing to browse through a thick operating manual to operate the instrument.

Since spring, field technicians for some of the nation's largest carriers have implemented Anritsu's newest Sitemaster analyzers, the S114B and S332B, to solve portability and operational challenges. Both instruments incorporate the testing capability of a spectrum analyzer and a VNA in one unit weighing only four pounds. The units were designed to perform tests much faster and more accurately by providing the spectrum analysis and vector measurement features in a single hand-held instrument.

Spectrum analysis capability is especially important in point-to-point signal analysis because it can be used as an initial test to get a quick review of signal strength. Using spectrum analysis, technicians can determine if there is a hole by checking if signal strength is below the threshold.

The new instruments also address multipath problems. The technician simply walks around the cell site's area with either analyzer to make sure the

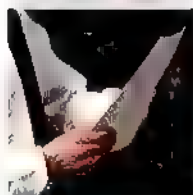
Lau is with the marketing department of the Microwave Measurement Division of Anritsu, Morgan Hill, CA.

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signal remains above the threshold. It is much more difficult to do this with a "portable" spectrum analyzer weighing more than 35 pounds.

Portability is also useful when deploying a WLAN or WPBX system inside an office building. In such a scenario, signal holes may not be easily simulated by some site simulation programs because of modeling complexity. A portable analyzer allows a technician to measure the site and to report back to confirm or notify site coverage that differs from the computer prediction.

Technicians are also using the

spectrum analysis feature to deploy a point-to-multipoint site. Most new RF radio designs specify a single outdoor unit (ODU) in which the RF circuitry is integrated with the antenna enclosure. The analyzers are being used to align the customer receiver antennas to the base station transmitter antenna and to ensure no interference signals are present that will impede the radio receiver performance. By connecting an analyzer to the IF output cable from the ODU, the technician can monitor the IF signal strength. Maximum signal level usually indicates the best alignment

path. While in this configuration, the IF cable's quality can also be determined.

Technicians can also assess the performance of a transmitter with the portable analyzers because the spectrum analysis function provides occupied frequency bandwidth measurement capability. Channel power and adjacent-channel leakage power of the radio transmitter can also be determined. The analyzer's 10kHz resolution allows examination of TDMA and CDMA signals from cellular or PCS sites, further aiding technicians as they travel from site to site.

Because field technicians need to perform much more than spectrum analysis these days, the analyzers have been designed with more measuring capability. The units have better than a -85dBm noise floor to help technicians quickly determine if there is signal interference. They can conduct all the other measurements that are required in the field, including return loss (VSWR), RF signal output power, cable loss, and distance-to-fault. All these tests are performed at laboratory-quality tolerances.

An RF power monitor option is also being used by technicians. With the option, broadband power can be measured from $+20$ to -45dBm with $\pm 1\text{dB}$ accuracy. Power can be measured in watts, in absolute decibels above 1mW (dBm), in relative power difference expressed as decibels (dBr), or as a percentage.

In addition to having multiple testing features in a lightweight housing, which inherently saves time, field technicians can conduct the tests rapidly because an intuitive and simple user interface guides technicians through the testing process. A menu-driven display requires the technician to make only a few keystrokes to conduct any of the standard tests. Results can easily be read under any conditions, even on cloudy days or at dusk, because the analyzers feature a large, backlit, VGA LCD.

The analyzers are also helping technicians back at the office. All traces can be downloaded to a database for data management or directly to a PC screen. The data can be exported as a metafile for reporting on-site deployment or maintenance. Data can also be downloaded into a spreadsheet for further analysis.

Today's field technicians have had the gauntlet passed to them for installing and maintaining cell sites. With additional sites to monitor and fewer technicians to do it, bulky multiple instruments are no longer sufficient. By using analyzers with spectrum analysis capability, the technicians can now meet the demands of the market: timely analysis on as many cell sites as possible. ■

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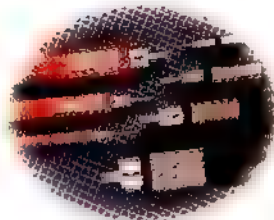


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Trapping transients: line surge protection

Data communications lines and equipment are vulnerable to electrical transients. Assessment of the application guides proper surge protection.

By Alex Gorosito

Today's data equipment is vulnerable to voltage surges and electrical transients. A single IC package can contain more than 100,000 memory bits and

more than 5,000 logic gates. The high sensitivity, due to the small size of the chips used in these packages, makes them susceptible to quick degradation from voltage surges and transients. PLCs, MUXs, HUBs, RTUs, SCADA,

and telemetry equipment are especially vulnerable to electrical surges because of their low operation voltages. Many of these components can be damaged beyond repair by an electrical surge as low as 20V.

Sources of electrical surges are numerous. The most common is a close lightning strike, which will affect nearby data lines through induction. Industrial transients caused by switching and commuting of electrical motors are also significant disturbances. The operation of such devices can cause abrupt shifts in the ground potential that can generate a current flow through a nearby dataline to equalize the ground potential.

Electrostatic discharge (ESD) is another form of an electrical surge that can be included in this group. Although often overlooked, ESD can harm fragile data equipment. ESD is caused by two non-conducting materials rubbing together, causing electrons to transfer from one material to the other. Once the material comes in contact with another object of lower electrical potential, a discharge occurs. Lightning strikes are

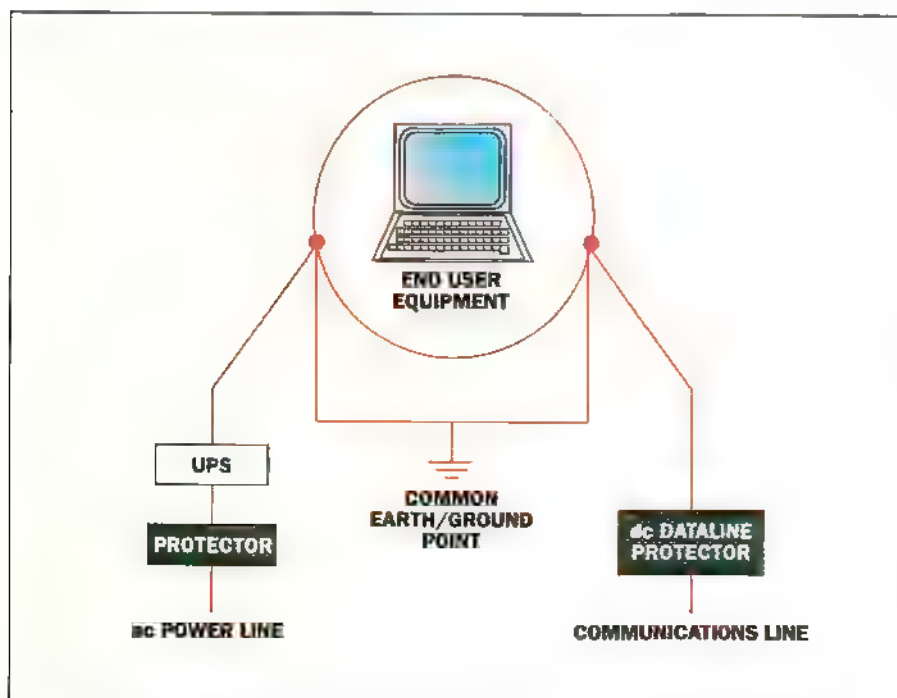


Figure 1. A lightning surge or transient can invade equipment via various routes.

Gorosito is a technical assistant with Criel America, Miami, FL.

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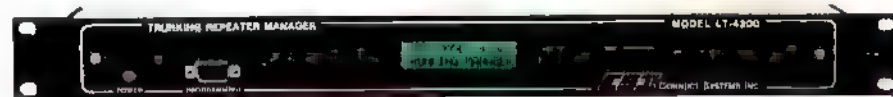
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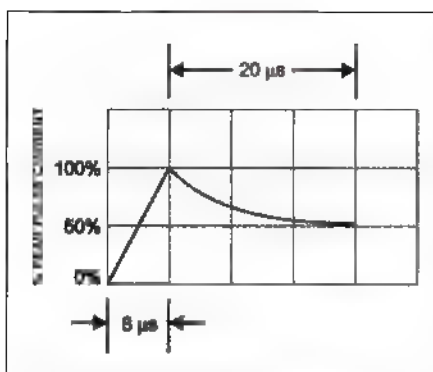


Figure 2. Power-handling capabilities of most surge protectors are commonly tested against a hypothetical surge in an 8/20 μ s waveform.

the most severe cases of ESD.

The consequences of electrical surges and transients may be severe. Although the event is brief, the amount of energy that is carried can be great. A typical transient event can last from a few nanoseconds to several milliseconds, carrying several thousand volts and at least a few hundred amperes of current. These events may cause burnt line cards, lockups, loss of memory, problems in retrieving data, altered data, and garbling. The user who first thinks of damage in terms of hardware problems or an

ac power-related problem often overlooks all these unfavorable effects.

Transient suppressors

Any piece of equipment can be considered as having a protective halo around it that can be invaded in two ways: through the power line or through the communication line (i.e., telephone line, coaxial line, RS-232, RS-422, R-485, RS-423, and 4-20mA current loop cables).

Figure 1 on page 26 illustrates how equipment, such as a dispatch computer, should be protected. Both the ac power line and the dc communication line provide direct paths through which voltage surges and electrical transients can travel and damage the equipment. A common mistake is to believe that a surge protector is not necessary on the ac power line because the uninterruptible power supply (UPS) provides adequate surge protection. The main function of the UPS is to provide continuous power for a limited amount of time during a brownout or power outage. Although the UPS may provide some protection, its power handling capabilities and response times are mediocre at best.

It is also vital that all surge protectors and UPSs be grounded to a com-

mon earth/ground as shown in Figure 1. This avoids differences in ground potentials that may generate a current flow through a nearby dataline to equalize the ground potential.

To protect equipment from incoming surges through the dataline, the user must first determine the electrical specifications of the equipment being protected. Generally, dc communications applications can be broken down into two line-type categories: twisted-pair wires and coaxial cable.

Twisted-pair applications are the most common form of wiring in data communications. They consist of two identical wires wrapped together in a double helix. Both wires in the pair have the same impedance to ground, making the pair a balanced medium. This characteristic helps to lower the wiring's susceptibility to noise from neighboring cables or external sources. A common example of a twisted-pair application is a telephone line. A single telephone line consists of two copper wires: one for transmitting electrical impulses and one to receive them. Coaxial applications, on the other hand, consist of a solid wire core surrounded by one or more foil or braided-wire shields, each separated from the other by a plastic insulator. The

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inner core carries the signal, and the shield provides the ground.

Protecting twisted pairs

Once the type of application is determined, the proper type of surge protector must be selected. Whether it is a twisted-pair or a coaxial application, surge protection selection is based on some basic questions. If the application is twisted pair, the four questions the user should ask are:

1. What is the application's nominal voltage?
2. What is the transmission speed of the data that are being passed?
3. What is the application's current rating?
4. How many pairs of these "twisted pairs" does the application include?

In selecting a surge protector, the nominal voltage of the twisted pair application must be known to assign a proper *clamping voltage*. According to Ohm's Law ($V = IR$), voltage is proportional to the current, keeping the series resistance constant. Once the voltage level reaches the surge protector's clamp voltage, the excess energy that may have damaged the dc communications equipment is diverted to a common earthground point.

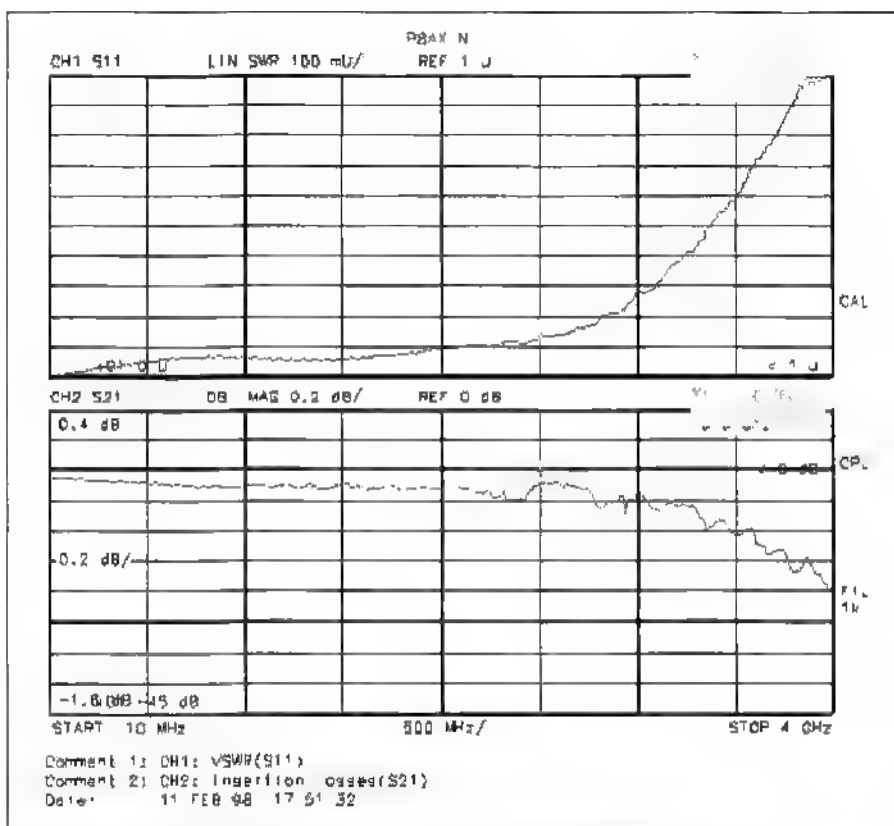


Figure 3: VSWR and Insertion loss of a Citel, N-type coaxial surge protector.

As a rule, the clamping voltage of a surge protector should not exceed 1.4 times the application's nominal voltage. Clamping voltages for typical

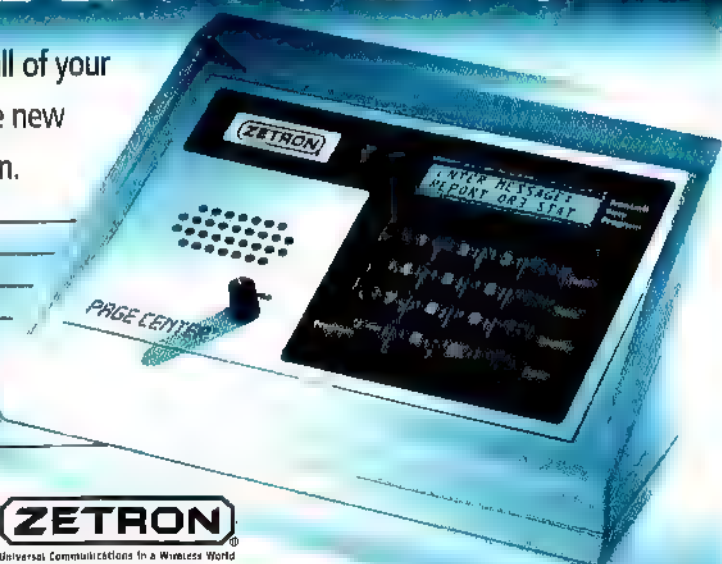
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Photo 1. Surge protector types (left to right): N-type with external ground screw; N-type bulkhead; BNC-type with external ground screw.

applications are shown in Table 1, above right.

In addition to knowing the application's nominal voltage, the transmission speed must be obtained. This information deals with the *capacitance* being placed on your twisted-pair line

by the surge protector. This parameter is important for high-speed data rate applications such as Category 5, 10Base T, RS-485 and T1/E1. Capacitance can cause signal loss, or it can be the *source* of signal reflections if not properly used in a specific data line. To select a

Table 1: Typical clamping voltages of common dataline applications

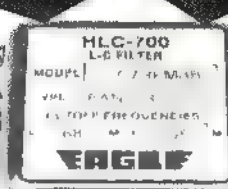
DATA LINE APPLICATION	CLAMPING VOLTAGE
RS-422	10V
Fire alarms	15V
RS-232	30V
Thermocouples	30V
Leased lines	55V
Telephone lines with ringing voltage	190V

transient voltage surge suppressor (TVSS) device with regards to capacitance and general protection against transient threats, it is recommended that the TVSS be first tested in the circuit under normal operating conditions.

NOTE: The transmission speed limit of standard data lines such as telephone lines, 4-20mA loops, and RS-232 is about 50kbps. Any application exceeding this limit should be considered a high-speed data (HSD) line, and a surge protector with a low capacitance should be chosen.

Identifying the *current* rating of the twisted-pair application is just as significant as the transmission speed and clamping voltage. TVSS devices for data lines such as RS 485, 4-20mA loops and telemetry equipment have


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current ratings of about 200mA. Applications that have higher current ratings (e.g., 500mA, 1A, and 2A) will cause premature failure to the surge protector with standard data line current ratings.

While determining the last three parameters, a simpler question must be kept in mind: How many of these twisted pairs need to be protected? Every wire connected to the equipment, even though it may not be in use, provides a path for harmful transients. In today's market, surge protector configurations range from one pair to 200- or 300-pair blocks.

Once all four parameters have been determined, the TVSS power-handling capability, also known as *peak pulse current* or *maximum discharge current*, should be investigated. These terms are defined as the maximum current that the surge protector can withstand for a given pulse duration. Pulse duration can be characterized as the length of time needed for the peak pulse current to reach a maximum value, plus the length of time needed for the peak pulse current to reach 50% of its peak value. Figure 2 on page 28 illustrates an 8/20 μ s waveform in which the power-handling capabilities of most surge protectors are commonly tested.

The waveform simulates "real-life" lightning-related surges. This is significant because the TVSS must be able to provide a low clamping voltage and be capable of diverting the lightning surge or industrial transient away from the dc communications equipment without short-circuiting.

Protecting coax

In a similar fashion, selecting appropriate coaxial surge protection boils down to four questions:

1. What is the application's frequency range?
2. What is the power rating?
3. What is the connector type of the application?
4. Is an in-line mounting style or a bulkhead mounting style preferred?

Coaxial surge protectors are composed of either gas discharge tubes or quarter-wavelength stubs. In both cases, the frequency of the coaxial equipment must be known. For example, the operating frequencies of PCS and L-band applications are about 1.92GHz and 800MHz, respectively. Gas-discharge tube surge protectors generally have operating frequencies as high as 4GHz with low leakage currents and insertion losses. Figure 3 on page 29 illustrates an N-type coaxial surge protector with insertion losses so low (0.066dB at

2.5GHz, 0.2dB at 4GHz) that the protector is practically transparent on the coaxial cable.

In addition to the frequency of the coaxial application, the power rating must also be known to assign a proper clamping voltage. Standard gas-discharge tube protectors are available to protect power ratings as high as 50W, 400W and 1,000W (continuous). As with the twisted-pair protector, once the voltage level reaches the coaxial surge protector's clamp voltage, the excess energy that may have damaged the dc communications equipment is diverted

to a common earth/ground point.

To connect the surge protector directly to the coaxial apparatus, a compatible connector type must be chosen. Common connector types are N-type, BNC, TNC, SMA and 7/16 DIN.

The installation type is also an issue. Typical mounting styles are available in in-line and bulkhead types. In-line protectors mount directly in-series with the coaxial cable, and grounding is done through an external ground screw that is attached to the body of the surge protector. The advantage to in-line protectors is that they are easy to install and they

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are suitable for retrofit applications. Bulkhead coaxial protectors are different only in the way they are grounded. Grounding is done through the chassis of the protector and the excess energy is discharged through the mounting panel. Bulkheads provide better electrical contacts for discharging excess energy from an electrical surge. Photo 1 on page 30 shows two types (with one modification) of coaxial surge protectors.

Placement of TVSS

Surge protectors should be installed at both ends of the dc communica-

tions line, whether they are for a twisted-pair or a coaxial application. Once transients have been diverted to earth/ground, they will continue to travel if there is a source of lower ground potential. Transients will travel to that source through the path of least resistance—probably a dataline. If only one end of the dc line is protected, a harmful transient can flow back into the dc communications line if the unprotected end is at a lower ground potential. With protection at both ends, it does not matter where the transient originates. It will always be

shunted to earth/ground, regardless of the difference in ground potentials.

Proper grounding

A protection system with a poor ground is the same as having no protection at all. Proper earth/ground connections are often overlooked. Recommended grounds are the utility company ground, a ground rod, well casings, and cold-water pipes that are composed of continuous metal.

NOTE: Metal water pipes may at times be repaired and/or extended with PVC plastic piping. An interrupting section of PVC pipe nullifies the cold water pipe ground. Thorough investigation of a cold-water pipe is important because the PVC repairs or extensions may be hidden behind drywall, ceiling or flooring.

Grounds that are unacceptable include sprinkler pipes, PVC pipe, conduit, buried wire and any ground that cannot be verified.

Grounds that are unacceptable include sprinkler pipes, PVC pipe, conduit, buried wire and any ground that cannot be verified.

Bonding ensures the most effective ground. Bonding ties all of the grounds in the building together electrically, preventing differences in ground potentials. As a result, it is necessary to ensure that the ground used for the ac power is the same as the ground used for the dc communications surge protectors.

In connecting your surge protectors to a common ground point, all ground wires must be as short as possible. It is imperative that the ground wire not be coiled nor looped. Remember that transients will travel by the path of least resistance. The ground wire should be as straight as possible so that there is no obstruction to earth/ground. Conductivity is a function of wire diameter, as well as composition. The larger the diameter, the better the conductivity of the ground wire. Overall, grounding systems should have no more than 5Ω of earth/ground resistance.

Shielded applications

Shield grounding divides into two schools of thought, those who advocate

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The CableMate comes standard with an RS-232 serial computer port. Optional applications software is available for benchmarking cable installations for future comparison and maintenance. A cable library giving velocity factor and impedance parameters for 66 cables is included. The user can add another 30 cables or change the existing cables listed.

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total shield grounding at both ends, and those who are in favor of floating one of the ends of the shield

The best shield performance is achieved when shield continuity is *not* broken and when shields are solidly grounded with a 360° termination to the chassis of the connected equipment at each end of the data/signal cable. However, the shield will provide a path for power frequency ground loops, which can degrade performance. Floating one end of the shield can eliminate these ground loops, but it can also lead to open-circuit voltages. These voltages can capacitively couple into the "protected" data conductors.

Standards and ratings

In some cases, the quality of surge protection is dictated by national or international standards such as ITU.K.22. This recommendation, in particular, seeks to recognize realistic facility transient stresses on telecommunication equipment connected to an internal ISDN T/S bus. The standard covers the following aspects of over-voltage and over-current conditions.

- surges due to lightning strikes on telecommunication lines or to the building housing the equipment.
- electrostatic discharges generated by users touching the equipment or adjacent plant.
- lightning transient surges on mains-voltage power supplies to the equipment.

Using the ITU.K.22 standard to protect facility equipment from transients will result in a protection scheme likely to provide immunity to naturally occurring transients within the facility. Achieving the desired protection will require the engineer to pay close attention to high-frequency events, such as suppressor response to high-frequency transients. The TVSS impulse discharge current rating should be adequate to handle the long-duration transients.

Other standards, such as UL497B, also provide a foundation of how communications line surge protectors should function under certain transient stress conditions. UL497B states that data communications and fire alarm circuit protectors consist of single- and multiple-pair air-gap arrestors, gas-tube arrestors, or solid-state arrestors, with or without fuses or other voltage-limiting devices. It also states that data communications and fire alarm circuit protectors are intended to protect equipment, wiring, and personnel against the effects of excessive potentials and currents caused by lightning in communication

alarm initiating or alarm-indicating loop circuits.

These industry standards, as well as ITU.K.22 and European markings such as CE, help determine if a surge protector will provide the level of protection required for sensitive communications equipment.

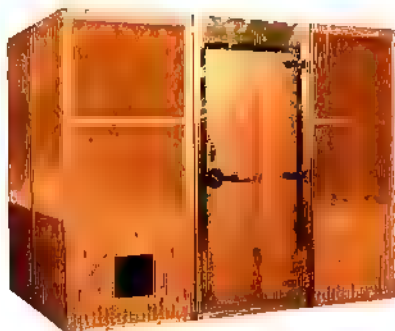
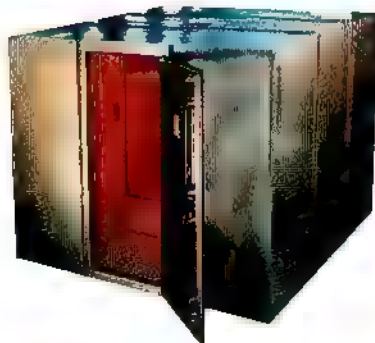
Take the proper steps

Data equipment is vulnerable to voltage surges and electrical transients. Users should be aware of the damage voltage surges, industrial transients and electrostatic discharges can inflict on

expensive and delicate communication equipment. Without adequate protection, the door is left open to damaging electrical surges. Steps should be taken to identify the types of dc communication equipment that need protection and to match surge protection to them.

Companies such as Citel America have designed fast-acting, low-clamping, high-discharge surge protectors for all types of dc communications lines. TVSSs can divert to ground all damaging transient voltages while remaining transparent to the system they are protecting. ■

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Do you cut your coax?

A benchmark standard approach to installing coaxial cable for mobiles will improve RF power measurements and improve reception quality in fleet vehicles.

By Patrick E. Buller

Do you cut your coax cable for your mobile two-way radio installations? We at Washington State Patrol (WSP) do. The reason? Repeatable test results.

The Washington State Patrol installs equipment in as many as 500 new vehicles and retrofits more than 100 vehicles each year. During the check-out phase, RF power measurements must fall within WSP standards (e.g., VHF: 100W forward power, 5W reflected power, UHF: 30W forward power and 1W reflected power). If these measurements do not meet specifications, the vehicle is set aside for further investigation to determine the fault. This is the point where frustration begins. The coaxial cables used to connect the radios to the antennas may be random in length. Coax that is terminated resistively with its own characteristic impedance will read "zero" reflected power. If SWR exists, the wattmeter readings will be different for each length of cable.

An antenna cut to exactly one quarterwavelength ($\lambda/4$) will have a nominal impedance of $37 + j22\frac{1}{2}\Omega$ (assuming sufficient ground plane). Reducing the length slightly will eliminate the reactive component, resulting in 37Ω resistance at the base, which yields a VSWR of 1.35:1. Therefore, if the wattmeter indicates 100W forward power and 2.2W or less reflected power, everything is normal.

As shown in Figure 1 above, a $\lambda/4$ cable can show an impedance from ground to infinity, depending on its length on either side of the $\lambda/4$. Note also that the impedance repeats itself every $\lambda/2$, except that the phase angle is

different. This feature can confuse the situation.

Consider a cable, less than $\lambda/4$ long, that is inductive-reactive. When attached to an exact $\lambda/2$ cable, the end result is capacitive-reactive because of the 180° phase shift of the $\lambda/2$ cable. It takes

band antenna via a duplexer. During the checkout phase, not all cars met the reflected power standard. Changing duplexers sometimes solved the problem, and at other times changing antennas solved the problem. Soon there were boxes of duplexers and antennas that

would be labeled "GOOD?", "BAD?" and so on. Investigation found the problem to be intricate.

Each individual component—antenna, duplexer and radio—performed according to specifications when tested with dummy loads. Specifications were met when connecting the antenna only to the radio, but when they were connected through the duplexer, a high VSWR was often indicated. When the same test was tried on

another vehicle, it successfully passed the test. The discrepancy was caused by different cable lengths. Although the antenna by itself was OK, the duplexer added a small amount of inductance on VHF that either canceled or worsened, depending on the length of the cable. Similar effects occurred at 450MHz.

The solution was to have all cables cut to an "electrical" multiple of $\lambda/2$ to provide a constant reference point whereby each faulty component could be identified. Physical length is unreliable because of manufacturing differences among cable suppliers and varying velocity factors.

Instrumentation

To correctly establish a reference point, a test cable is assembled to the electrical $\lambda/2$, including the NMO antenna mount

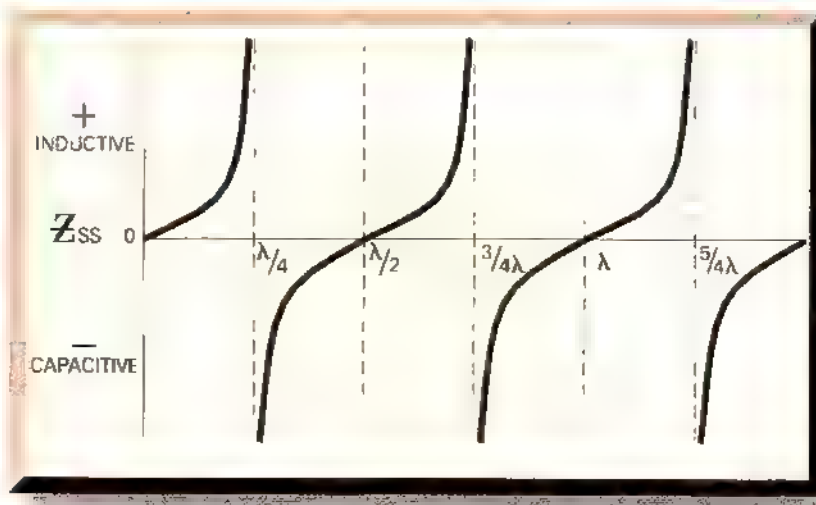


Figure 1. A quarterwave ($\lambda/4$) cable can show an impedance from ground to infinity, depending on its length on either side of the quarterwavelength.

a full wavelength (1λ) cable to repeat the exact phase. If the cable length is somewhere between $\lambda/2$ and 1λ , and not terminated in its characteristic impedance, its impedance can be changed as seen from the sending end because of the $\lambda/4$ influence. A $\lambda/4$ cable can also be attached as a stub to a cable of the same impedance, adding reactive components, or an open or a short, as determined by the length.

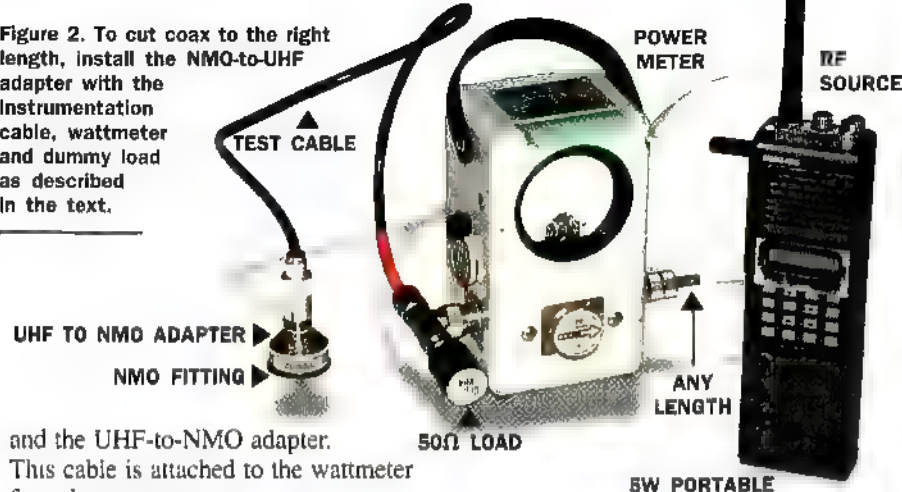
This method was popular many years ago in the CB business when someone used the wattmeter in the reflected mode and began cutting the coax cable from the antenna until the meter read zero. This fooled the transmitter, but the cable mismatch was still there.

"Ya got yer coax cut" was the catch phrase of the time.

WSP cuts cables to establish a common point whereby all measurements would use the same reference. Case in point: WSP had both 150MHz and 450MHz radios connected to a dual

Buller is an electronics design engineer for the Washington State Patrol, Bellevue, WA. He is also a member of IEEE, NARTE, RCA, APCO and ARRL.

Figure 2. To cut coax to the right length, install the NMO-to-UHF adapter with the instrumentation cable, wattmeter and dummy load as described in the text.



and the UHF-to-NMO adapter. This cable is attached to the wattmeter for subsequent measurements.

Connect a cable to port 1 of a coaxial "tee." Connect a 50Ω resistive (dummy) load to port 2 of the tee. Connect the male side, port 3, to a wattmeter, (one capable of forward- and reverse-power readings), as shown in Figure 2 above. Temporarily connect the other end of this cable to the UHF-to-NMO adapter, and screw it onto a NMO antenna mount. Do not attach cable to the NMO mount at this time. Use a 5W portable radio at the desired frequency as the wattmeter power source for the measurements. Cut the cable until no reflected power is indicated on the wattmeter. The result is an electrical $\frac{1}{2}\lambda$, including the NMO mount. You have just set up the lab conditions whereby all further tests will be done

Cutting the coax

Once this benchmark cable is available, the process can begin. The vehicle installation will obviously include a cable from the NMO antenna mount to the transmitter location. To cut this coax to the right length, install the NMO-to-UHF adapter with the instrumentation cable, wattmeter and dummy load as previously described and shown in Figure 2. Apply power to the wattmeter and note the reflected power. Cut the coax cable in small segments ($\frac{1}{4}'$) until the wattmeter reads "zero" reflected power. At that length, the cable is a multiple of an electrical $\frac{1}{2}\lambda$. The $\frac{1}{2}\lambda$ cable is open where the cut was done, which reflects to the wattmeter an open circuit that does not affect the 50Ω fixed load.

Now install the proper connector on the transmitter end of the cable and connect this end to the appliance of your choice. If you are now curious about the velocity factor of the cable, measure the physical length and compare it to the $\frac{1}{2}\lambda$ formula of $5,905/\text{MHz}$ in inches. The quotient divided by the physical cable length is the velocity factor—usually 0.66 for most coax and 0.8 for foam

Because the cable is some multiple of $\frac{1}{2}\lambda$, all measurements will be reasonably accurate. If some component other than the cable is not within specifications, it is easy to replace one or the other items connected on either end of the coax cable.

Note that $450\text{MHz} = 3 \times 150\text{MHz}$. A $\frac{1}{2}\lambda$ for 150MHz is $\frac{1}{2}\lambda$ for 450MHz. Makes it simple, doesn't it? When using a duplexer for dual band operation, it is necessary to make the cable connecting each radio to the duplexer also a multiple of $\frac{1}{2}\lambda$. Now that everything is compared to a $\frac{1}{2}\lambda$, any measurement out of order can be found by replacing the defective component. Should one, by chance, replace a good antenna with a good antenna, test results will be the same. However, replacing one bad component with a good one will yield immediate acceptable results.

Samples of cable lengths of RG8X used in the WSP shop are as follows:

- ☐ wattmeter to UHF/NMO adapter, 29.5' (tip-to-tip).
- ☐ 450MHz radio to duplexer, 23.0' (tip-to-tip).
- ☐ 150MHz radio to duplexer, 21.25" (tip-to-tip).

Note: The Patrol has found that it is most efficient to use RG8X instead of the normal run of RG-58/U, especially for the 450MHz band. Some vehicle installations have coax runs in excess of 25 feet. Instead of having two sets of cable and connectors, it is easier, and most cost-effective, to have one type each of cable connectors and crimp tools on the job.

This attention to detail may seem trivial for the shops having but a few mobile installations per month. However, for "mass production," this concept may prove well worth the effort, especially if one cares about workmanship. Additionally, improving the RF power standards will yield better reception for your fleet vehicles operating in fringe coverage areas.

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The versatile SINAD meter

By Harold Kinley, C.E.T.

I remember, back when I first started working in the land mobile radio field, that we were taught how to measure receiver sensitivity using the 20dB quieting method. We were also taught to "tune" a receiver using the quieting method along with the plug-in test sets that were generally used for troubleshooting and alignment work. Whatever happened to receiver and transmitter metering jacks and test sets? At some point in the '70s my boss bought a SINAD meter for me to try out. It was Helper Instruments' model S103. My first thought was the old paradigm: "What's wrong with the way we have always done it?" After using the SINAD meter for a short time, I discovered what was wrong was the way we had always done it.

It was a real eye-opener to go back and check receivers that were aligned using the 20dB quieting method against the 12dB SINAD method. Practically all of the receivers that were aligned using the 20dB quieting method had to be "touched up" with the SINAD method to meet specifications.

One of the biggest advantages of the SINAD method is in tuning adjustments that affect the bandwidth of filter circuits. Most bandpass filter circuits in receivers have an impedance-matching

adjustment at their input and output. This adjustment also affects bandwidth. If the adjustment is made using a continuous wave (CW) signal (as it is with the 20dB quieting method), then it is possible to tune the filter for a frequency response that is too narrow to allow the sidebands of a fully modulated FM signal to pass without severe attenuation.

Practically all of the receivers that were aligned using the 20dB quieting method had to be 'touched up' with the SINAD method in order to meet specifications.

The resulting distortion degrades the SINAD sensitivity of the receiver.

What is SINAD?

The acronym SINAD stands for *signal, noise and distortion*. The signal portion of the composite SINAD signal is specified to be 1,000Hz. The SINAD meter contains a sharp notch filter that is (or should be) tuned to notch out the 1,000Hz signal, leaving only the noise and distortion components to be

measured. The setup for performing the SINAD sensitivity test on an FM receiver is shown in Figure 1, below.

If the squelch control is set to unsquelch the receiver with no signal input to the receiver, then the SINAD meter will automatically set the noise output to 0dB SINAD. If the FM signal generator is modulated by an accurate 1,000Hz tone (to about $\pm 60\%$ system deviation), the composite signal (1,000Hz + noise + distortion) will be present at the input to the notch filter inside the SINAD meter.

An AGC amplifier is used to keep the composite signal at a constant level at the input to the notch filter, regardless of the makeup of the individual components of the composite signal (see Figure 2, below). As the signal level to the receiver input is increased, the signal component (1,000Hz) becomes a greater part of the composite signal at the input to the filter. At the same time, the noise component is reduced. The notch filter removes the 1,000Hz component, and the remaining noise and distortion components appear at the output of the notch filter and are measured by the metering circuit.

The point where the remaining noise and distortion components are reduced by 12dB below the composite signal is the point where the -12dB SINAD sensitivity of the receiver is taken. At this point, the RF level of the signal generator is the -12dB SINAD sensitivity of the receiver.

Once the -12dB SINAD point is determined, the *modulation acceptance bandwidth* should be measured. The RF level from the generator is increased by 6dB (double the microvolts). This will improve the SINAD reading to something better than -12dB. Now, increase the deviation until the SINAD meter again indicates -12dB SINAD. At this point, the deviation level of the generator is taken as the modulation acceptance bandwidth of the receiver. It is stated as $\pm "X"$ kHz. Check the level against the

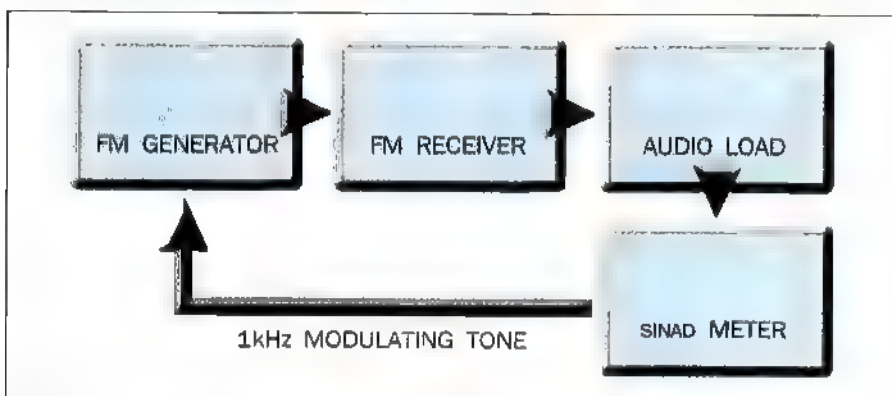


Figure 1. This is the basic test setup for measuring the -12dB SINAD sensitivity of a receiver.



Figure 2. Basic block diagram of the SINAD meter. The 1kHz tone is removed by the notch filter leaving only the noise and distortion components to be measured.

Contributing Editor Kinley, MRE's technical consultant and a certified electronics technician, is regional communications manager, South Carolina Forestry Commission, Spartanburg, SC. He is the author of *Standard Radio Communications Manual, With Instrumentation and Testing Techniques*, which is available for direct purchase. Write to 204 Tangewylde Drive, Spartanburg, SC 29301.

Kinley's email address is hkkinley@home.com.

specifications for the particular receiver.

Measuring distortion

The SINAD reading can be converted to percent distortion. To check the distortion figure of a receiver, the signal generator is set to a high RF level (500 μ V 1,000 μ V). This reduces any noise in the receiver output so that the SINAD meter is predominately looking at distortion components. The generator deviation should be set to 50% to 60% system deviation at 1,000Hz. If the receiver is producing 10% distortion, the SINAD reading will be -20dB. The standard -12dB SINAD point represents 25% distortion. To convert from SINAD to percent distortion, use the following formula:

$$D = \text{antilog} \left(\frac{dB}{20} \right) \times 100$$

where

D = distortion in percent

dB = SINAD reading entered as a negative figure.

To convert percent distortion to SINAD, use the following formula:

$$dB = 20 \log \left(\frac{D}{100} \right)$$

The following table converts between percent distortion and SINAD:

SINAD IN dB	DISTORTION(%)
12	25.1
14	20
16	15.8
18	12.6
20	10
22	7.9
24	6.3
26	5
28	4
30	3.2

On some SINAD meters, the scale doesn't allow measurements of SINAD readings below -20dB SINAD. Other instruments allow readings better than -30dB SINAD. A receiver's distortion level should be measured at its rated audio output. It is a good idea to check the distortion level of a receiver before performing the SINAD sensitivity check. If the distortion level is high, the -12dB SINAD point may not be achievable.

Audio power output

Because the SINAD meter has a root-mean square (RMS) voltmeter, it can be used to set or measure the audio output power from a receiver. If we know the load impedance and RMS voltage, the power can be calculated from

	1W	1.5W	2W	2.5W	3W	3.5W	4W	4.5W	5W
2.0 Ω	1.4V	1.7V	2.0V	2.2V	2.4V	2.6V	2.8V	3.0V	3.2V
3.2 Ω	1.8V	2.2V	2.5V	2.8V	3.1V	3.3V	3.6V	3.8V	4.0V
8.0 Ω	2.8V	3.5V	4.0V	4.5V	4.9V	5.3V	5.7V	6.0V	6.3V

$$P = E^2 \div R$$

where P = power

E = rms voltage

R = load impedance

The formula can be rearranged to calculate power from voltage as

$$E = \sqrt{PR}$$

The above table converts power to voltage at several values of impedance.

A non inductive audio load should be used at the output of the receiver with the SINAD meter connected across the load resistor. The SINAD meter can be switched from RMS voltage measurement to SINAD measurement to measure



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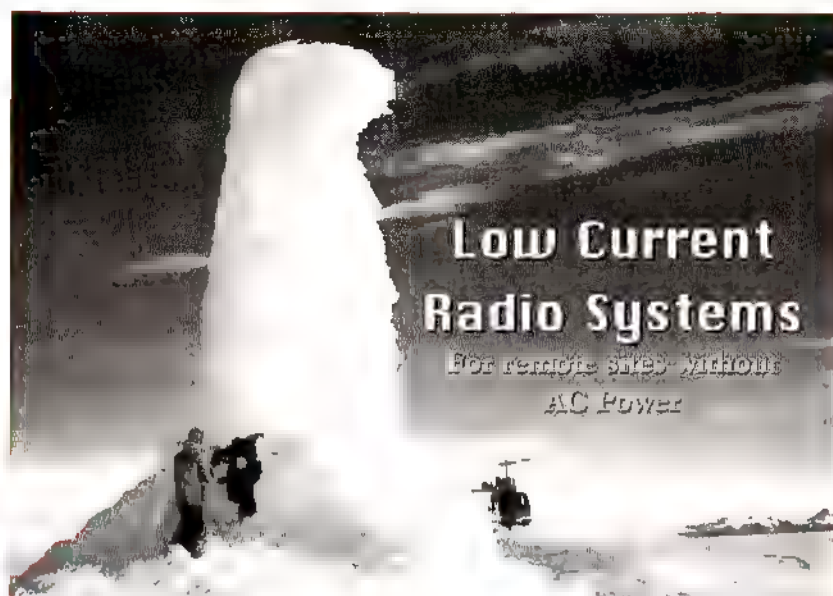
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the distortion at any power level within the receiver's audio output range. "Technically speaking," the -12dB SINAD measurement should be made with the audio level from the receiver at least half of the radio audio output power level. This is in accordance with EIA specifications

Additional applications

Other uses of the SINAD meter include signal tracing in audio stages of the receiver or transmitter. Stage gain measurements can be made easily because the SINAD meter is capable of measuring audio voltage below 10mV. The SINAD

Other uses of the SINAD meter include signal tracing in audio stages of the receiver or transmitter.

meter also can be used to send a tone over a line (remote control line), while a second SINAD meter at the other end measures the tone level. The far end should have a 600Ω termination. If a 0dBm tone is injected in one end, and the SINAD meter on the other end indicates -16dBm, then the line has a 16dB loss. The measuring instrument can be switched to the SINAD position to measure any distortion on the line. Be sure to use 600Ω/600Ω isolation transformer between the instrument and line on both the *generate* and *measure* ends of the line. This prevents unbalancing the line, causing a hum problem.

Calibration: a final detail

It is important to make sure that the 1,000Hz tone that is used for any tests with the SINAD meter is accurate. If the tone does not fall deep into the notch of the instrument, valid SINAD measurements cannot be made because the tone itself will be seen as noise and distortion. Make sure that the SINAD meter automatically zeroes with only noise at the input. Internal adjustments are provided to properly zero the SINAD meter and to properly adjust the notch or set the audio tone to exactly match the notch filter.

These are just a few examples of the SINAD meter's versatility. There are many more uses for this instrument, limited only by the imagination of the user.

Until next time—*stay tuned!*

Ericsson PRS offers new radio products with digital modulation

Ericsson Private Radio Systems has rolled out new radio communications products with digital modulation, along with adding to its conventional and enhanced digital access communications (EDACS) systems.

The new digital products, called Provoice and Jaguar, are a next generation of digital radios that accompany the company's Aegis line. Conventional analog FM products are marketed under the Panther brand.

"As for the Provoice digital modulation, it uses the 'improved multiband exciter' (IMBE) voice encoder, or vocoder," said Dominick Arcuri, vice president of engineering at Ericsson PRS.

A vocoder converts a voice into a digital code. The comparable Aegis product uses the AME vocoder.

Provoice equipment has been installed in central Virginia; Ottawa, CA; and in Vancouver, British Columbia. Installations are in progress for Coral Gables, FL, and Albuquerque, NM. The equipment has been selected for San Antonio, but no contract has yet been issued.

Another new product, the EDACS 500M trunked mobile transceiver, straddles the EDACS and Provoice applications.

"It has mid-range features and is competitively priced," Arcuri said. "It works with EDACS or Provoice. It will carry data communications. It fits trunked data applications, including work-order

dispatch and traffic inquiries."

Arcuri said that Ericsson has installed 450 EDACS systems worldwide. He said that Florida Power and Light had signed a contract in May for a 45-site, 900MHz EDACS system.

Some military agencies with frequency exclusivity have chosen EDACS for trunked systems. Among commercial customers, EDACS use is more common in the upper UHF-T band.

Ericsson PRS focuses on trunked radio for public safety and on conventional radio for business and industrial (B&I) customers. It does not offer trunked B&I radio, including decentralized trunking. Some SMR system operators use EDACS, although some others consider it to be too feature-rich and too expensive for "plain-vanilla" dispatch services.

Within this focus, Ericsson also provides trunking systems to utility companies, which can be considered industrial or public safety customers. **DB**

Ericsson EDACS users in North America

- 53 utility companies
- 76 SMR system operators
- 104 public safety agencies
- 12 airports
- 20 commercial users
- 21 federal agencies

Motorola, Johnson affiliate for sourcing, licensing

Motorola, Schaumburg, IL, and the EFJohnson subsidiary of Lincoln, NE-based Transcrypt Secure Technologies will work together on licensing and sourcing of land mobile radio products.

Under terms of a memorandum of understanding announced Sept. 7, Motorola will license the LTR-Net protocol from Johnson. LTR-Net provides enhanced features and wide-area networking for SMR service providers and is compatible with many LTR radio systems. Motorola already supplies LTR-compatible radios.

"We expect a favorable impact to our bottom line in year 2000 and beyond from these new business initiatives," said

Transcrypt Chairman Michael E. Jalbert. "Our companies have previously entered into agreements for intellectual property rights related to Motorola's Smartnet, Smartzone and Project 25 technology."

Among Transcrypt's new products for 1999, Johnson introduced the LTR-Net system, and Transcrypt Secure Technologies introduced encryption modules for mobile radios, including the latest Motorola models. It introduced voice security modules for Nokia and Qualcomm cellular phones.

Johnson plans to introduce handheld land mobile radios and digital mobile radios that meet the Project 25 standard. **DB**

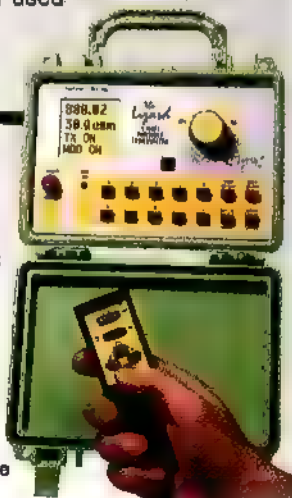
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FCC Notes

The FCC reassessed the **45MHz CMRS spectrum cap** and the cellular cross-interest rules and found that they "continue to be necessary to promote and protect competition in CMRS markets." The commission did allow more cross-ownership and adopted a spectrum cap aggregation limit **increase from 45MHz to 55MHz in rural areas**. That increase, the commission said, "should facilitate the deployment of service, particularly PCS, to rural areas without presenting a significant risk to competition in those areas." ... Proposals that FCC Chairman **William Kennard** has presented to Congress include **restructuring the FCC** along the functional lines of enforcement, consumer information, licensing, competition/policy and international communications. These functional areas would **replace the current industry-specific bureaus within five years**. Kennard also reported that the commission is developing a plan to allocate and assign as much as **200MHz of spectrum for a broad range of new services**, such as expanded wireless communications services, advanced mobile communications services and new spectrum efficient private land mobile systems. DK

Freeman combines service, tower operation

At Freeman Communications, Elmira, NY, servicing radios forms the largest part of the business.

"Some of our customers have bought radios by mail order, and we fix them," said Greg Freeman, one of the owners of the company. Repairs primarily involve antennas and batteries on portables, and antenna components on mobiles.

The dealership, which serves the counties of Chemung, Schuyler, Steuben and Tompkins, sells 100 to 500 radios annually for simplex and repeater communications, including business and industrial, and government customers.

Construction companies account for the largest segment of sales, along with taxi companies, towing businesses, ambulance services and police/fire agencies. The construction companies primarily buy portables.

What began for Freeman 25 years ago as a radio hobby turned into a business. He first sold CB radios with his father and soon converted to selling commercial equipment. Freeman Communications also operates three towers and provides tower space, antenna installation and repair.

Four dealers compete for business in

the area Freeman serves. Yet, a spirit of cooperation exists among them.

"Each occasionally subcontracts installations and service calls with each other to accommodate deadlines and workflow. The dealers cover for each other during vacations and training seminars. We don't steal customers from one another," Freeman said.

Competition from Nextel, cellular and PCS has had no effect on his business. Freeman said, "The economy is doing good, so we're doing good."

Freeman Communications carries Uniden, Maxon and Vertex/Standard products and is a factory-authorized reseller for Zetron, David Clark and C.E.S. The company uses Vertex most often for repeaters and mobiles. Maxon usually is preferred for portables and control stations.

"For mobiles, it depends on the application," Freeman said. "Maxon mobiles are somewhat larger than Vertex mobiles." Word-of-mouth references bring Freeman Communications more customers than any other method. Freeman said.

The company's Web site address is www.fccusa.com. DB

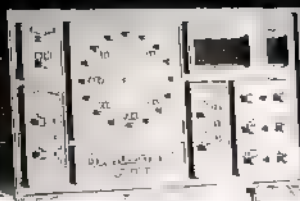
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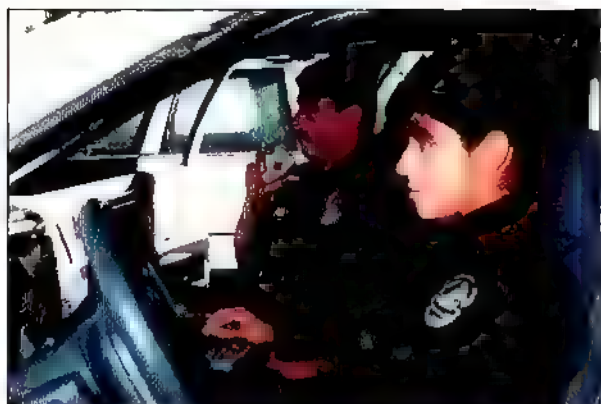
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LAPD upgrades with Motorola

Armed with the power of a new \$21.6 million mobile data system, the Los Angeles Police Department (LAPD) can now simultaneously manage multiple emergencies, such as explosions, earthquakes and fires, in separate parts of the city without compromising communications for ongoing, routine calls. The system, a Motorola 800MHz Private Datacat with Mobile Workstation 520 (MW520) mobile computing devices, is part of the LAPD's upgrade of its Emergency Command and Control Communications System (ECCCS). It replaces a mobile data system the department originally purchased in 1983. *RI*

Pricing brings curious visitors to NTX-Comm's Web site

"They see the pricing, and it gets them curious," said Alan Jackson, owner of NTX Comm Supply, Henrietta, TX.

Jackson was referring to the steady increase of inquiries he receives over the Internet at his Web site, www.ntx-comm.com. Even so, site visitors are somewhat reluctant about ordering mobile radios because of the steps needed to program and to install them.

"A local dealer would know the frequencies and tone squelch standards for his area, and he can install the equipment," he said.

Jackson said he sees the industry "tilting" toward product that allows users to program radios. "Installing the radios is not complicated," he added.

NTX caters to local customers, including fire and sheriff's departments. The company sells 60 to 70 radios per year, most of which are used on VHF repeaters by public safety users. Jackson outsources repairs.

Jackson said he got into the business about 10 years ago, responding to friends who were volunteer fire department members. *DB*



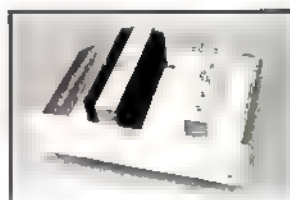
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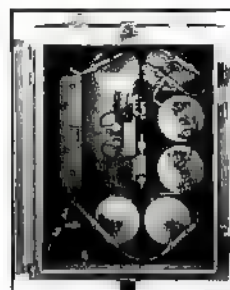
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News Notes

Berkeley Varitronics Systems, Metuchen, NJ, has won a contract from **Telecell One** to provide CW drive test equipment comprised of Gator transmitter and Panther four-band receivers for GSM build-out in Africa. **Texas Instruments**, Dallas, has awarded Berkeley a contract to provide 2.4GHz microcell test tools, including its Lizard 1W transmitters and Mongoose receivers. (www.bvsystems.com) ... **Softwright**, Aurora, CO, conducted its ninth annual Terrain Analysis Package engineering seminar Sept. 27-29. (www.softwright.com) ... Melbourne, FL-based **GE Harris Railway Electronics** will use satellite services from **Orbcomm**, Dulles, VA, as part of its Pin-

point locomotive tracking system. "The Pin-point system is poised to transform the way in which the railway industry monitors and communicates with its mobile and remote sources," said **Kevin Clyne**, business development manager, communications systems, for GE Harris. (www.orbcomm.com) ... **ReIm Wireless**, West Melbourne, FL, reported higher revenues for its land mobile radio products during the second quarter of 1999, up \$1 million, or 16%, compared to the same period last year, thanks to shipments to the U.S. Army. (www.reim.com) ... **Emergystat Ambulance Service**, Vernon, AL, has installed a satellite-based dispatch radio network from **SatCom Systems**, Burbank, CA. Explaining why his company uses satellite service for its

two-state region, **Dave Robertson**, Emergystat's vice president, said, "Cellular coverage is unreliable in much of this area on any given day, and terrestrial two-way VHF/UHF radio systems require a significant capital investment in leased landlines and repeater sites for wide-area coverage." ... **Motorola** has appointed **Andrew**, Orland Park, IL, as its global supplier for base station antennas and transmission line products. ... For 9-1-1 emergency dispatch system customers of its Netclock time synchronization equipment, **Spectracom**, East Rochester, NY, has prepared a Y2K emergency procedure for use in preparing contingency plans. It can be viewed on the company's Web site. (www.spectracomcorp.com) ... **Advanced Charger Technology**, Norcross, GA, has formed nine alliances to distribute chargers for two-way radio batteries in northern Europe. (www.actcharge.com) ... **CapRock Communications**, Friendswood, TX, offers **Kenwood** and **Motorola** repeaters, mobiles and portables for rent under a new, nationwide dealer subrental program. "We've reduced shipping time and prices," said **John Grau**, general manager of CapRock's Wireless Division. "Kenwood dealers should find our rental program especially advantageous because of our discount program through Kenwood." (888-482-9090) ... For its nationwide fleet, **Gas Supply**, Tulsa, OK, has purchased the **Eaton Fleet Advisor** system with on-board computing, mobile communications, GPS and back office networking capabilities. Gas Supply's system will use the satellite-based **MSAT** packet-switched data mobile communications network for mobile communications; **Bell South Wireless Data's** terrestrial Mobitex network is another option. Gas Supply's challenge was to convert from regional to centralized dispatching and "still maintain good communications with our drivers and customers," said **Greg Greer**, the company's transportation manager. (www.fleetadvisor.com) ... **EFJohnson's** Hong Kong sales office has been closed at a cost of \$523,000 for severance expenses and other costs. "We made the decision to close the office as we believe the company will be better served by increasing its focus of wireless sales in the North, Central and South American markets," said **Michael E. Jalbert**, chairman of Johnson's parent company, Lincoln, NE-based **Transcrypt Secure Technologies**. (www.transcrypt.com) ... **Nortel Networks** and **Harris** have chosen **Signapro** software for broadband system design. The software is provided by Eugene, OR-based **EDX Engineering**. **Wireless Facilities**, San Diego, has also chosen **Signapro** to aid in designing broadband systems (www.edx.com). ... **RFS Cablewave**, Menden, CT, will supply cable, connectors and accessories for **OmniPoint Communications'** expanding wireless PCS network. ... **Multipier Industries**, Mt. Kisco, NY, has received ISO 9001 certification. The battery-pack manufacturer worked for a year and a half to improve and to document its procedures to conform with ISO standards.



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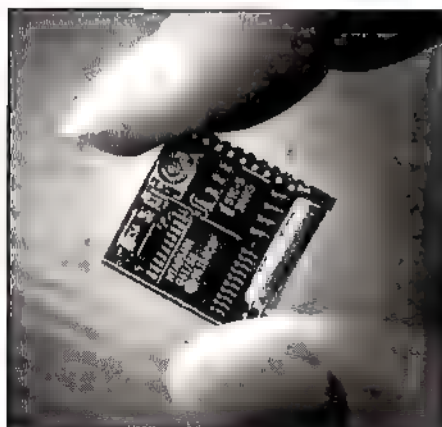
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Benchtop equipment

Battery system offers fast way to test batteries

iTECH's IQten programmable, networked battery test system offers a fast, easy way to test batteries. It features 100mA-2,000mA of programmable power at each battery station. One swipe of the bar code wand programs each battery station. Test reports show all test results and provide a performance receipt at a laser printer. As many as 80 battery stations network to one remote console unit. The system works with



many existing battery adapters.
Circle (351) on Fast Fact Card

Test sets maintain radio systems



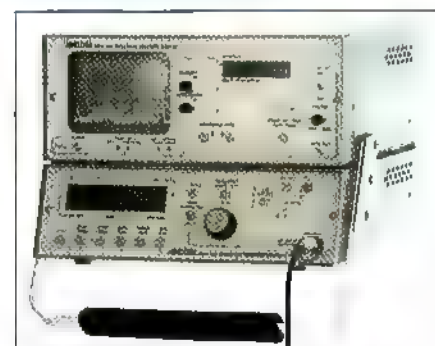
The Convex 806A/TIMS test sets support a wide range of communications systems. These general-purpose instruments are used to install and maintain radio and telephone systems.

A high-precision delay measurement is provided for optimizing simulcast radio systems. The set also measures the ability of the communications facilities to pass signals and quantifies impairments that degrade transmission. The test set comes in rack-mounted and portable/benchtop versions. Convex is represented by Simulcast Solutions.

Circle (352) on Fast Fact Card

Analyzer offers accurate measurements

AVCOM's MSA-90A microwave spectrum analyzer covers a frequency range of 50kHz to more than 1GHz and uses direct frequency synthesis to assure center frequency measurements to 1kHz accuracy. The ergonomically designed controls allow fast input of operating parameters by using a rotary encoder and simple push-button option selections. Frequency resolution is accomplished by seven IF bandwidth filters ranging from 3MHz to 3kHz. Any selected center frequency can be instantly monitored by pressing one button that sets the frequency span to zero and enables the built-in demodulator and audio amplifier. AM and FM demodulation is



standard in the analyzer. Operating parameters can be easily stored and recalled for later use because of internal memory registers.

Circle (353) on Fast Fact Card

Radio test set emulates TETRA environments

IFR's 2968 TETRA radio test set performs the on channel transmitter measurements required in a TETRA production environment. Burst and continuous power measurements, vector modulation accuracy and frequency error are supported. Receiver

measurements are supported by generation of the T1 test signals. The 2968 can also support the main world wide trunking format (MPT1327), GSM digital cellular and all of the international analog cellular standards.

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READERS' CHOICE

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Modem, amplifier are certified by the FCC



Young Design's model 2400 frequency-hopping, spread-spectrum radio modem and the model AMP2440 pole-mounted, bi-directional amplifier have been certified by the FCC for license-free operation in the 2.4GHz band. Ranges

farther than 50 miles (line-of-sight) can be achieved with modem and amplifier when used with 24dB-gain, grid dish antennas. The radio modem and amplifier have been certified with a range of omni, yagi and grid dish antennas. The radio modem is an RS-232 interface and operates point-to-point or point-to-multipoint at speeds as fast as 115.2kbps asynchronous. The radio modem can be used without the amplifier for short-range links using small whip antennas and several miles using outdoor gain antennas. The radio modem, a waterproof bi-directional pole-mounted amplifier, consists of a low-noise receiver pre-amplifier as well as a transmit power amplifier.

Circle (500) on Fast Fact Card

Delay timer protects radio equipment

A delay timer from Globe Electric and AC/DC Industries is designed to enhance public safety and industrial communications systems. The delay timer protects batteries, two-way radio equipment, computers and cellphones. The MZL-10 series is a programmable delay timer that starts timing when the voltage starts dropping. This will allow the continuous operation of communications equipment for a preset period of time. A dipswitch allows the user to select or to change the preset period. A built-in voltage detector can override the timer and shuts all connected communications equipment off when the battery is weak. The timer also features high-voltage protection and a diagnostic LED. The compact unit is sealed from moisture and vibration. It operates in the temperature range of -40°F to 185°F and is rated intrinsically safe.

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Circle (41) on Fast Fact Card

Headset adapter for remotes offer small footprint

Ventronics' headset adapter for CPI remotes provide a compact connection for dispatchers. The noise-suppressing headset adapters are compatible with popular tone and dc remotes. The model HA-CPI-FS adapter allows use of any brand or model of PL-237-type powered telephone headset and is fully compatible with the CPI-TR20 and DR20. Features include a small desk footprint and provisions for foot pedal operation. Internal switching and connectors allow for serial con-



nection of remote panels for simultaneous operation.

Circle (402) on Fast Fact Card

Van antenna system hides in storage pipe



STI-CO Industries' discreet antenna system for law enforcement operations comes in a surveillance vehicle disguised as a contractors' van. Its rooftop "storage pipe" contains a custom-engi-

neered system that includes multiple, working antennas specifically tuned to operational requirements. The system provides upgrade alternatives to existing van installations. The completely disguised tubular enclosures make adapting off-the-shelf antennas unnecessary, and they eliminate the need for multiple external antennas. The antennas have built-in ground planes and require no field tuning. They provide unobstructed omnidirectional communications, unlike antennas used inside the vehicle.

Circle (403) on Fast Fact Card



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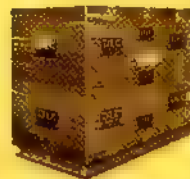
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Circle (45) on Fast Fact Card

Modem, base station deliver high-speed data



Dataradio's Gemini^{PD} and Paragon^{PD} are designed for private radio networks. The Gemini^{PD} mobile data radio modem uses dual receivers to decode messages simultaneously to improve performance in multipath and fading environments. The "parallel decode" technology, along with the DSP-based modem, can produce fewer retries and more effective throughput. Other features include a GPS receiver, as many as 16 over-the-air programmable channels with automatic channel changing and three RS-232 data ports with a built-in multiplexer.

Circle (404) on Fast Fact Card

Receiver detects RF emissions, alerts user

The RF Bug from National Communications Group is used with an analog or digital phone. It has a circular display of six light emitting diode bulbs and a small antenna that detects the presence of nearby RF. When exposed to RF (such as an incoming cellphone call) the lights flash in a clockwise direction, silently alerting the user to the active RF field in the area. The RF bug also detects other forms of radio and electronic emissions, such as those from surveillance cameras and hidden microphones.

Circle (405) on Fast Fact Card

Microwave radios extend channels

The substrate LEDR microwave radio from Adaptive Broadband provides full-duplex, scalable bandwidth and capacity from 64kbps to 768kbps in a 200kHz channel. These radios can operate in a point-to-point environment with a wide range of applications. They are suitable for telecommunications access and transport links, wireless backbones for SCADA systems, and as backhauls to extend existing channels. The radio is designed to connect to any industry-standard EIA-530 or V.35 source.

Circle (406) on Fast Fact Card

RTU offers 12-bit conversion

The model 1732 remote terminal unit (RTU) from **Zetron** features 12 bit analog/digital conversion for accuracy. It can be expanded in modular increments to a maximum of 445 points with analog, digital and pulse-count inputs for pressure, temperature, flow, power and other sensors while analog, digital and relay outputs interface to valves, motors, alarms, pumps and other controls. Each unit features extensive, on-board user-programmable logic for systems such as pump rotation, communications fail/fall-back control and data logging.

Circle (407) on Fast Fact Card



Gate lock enhances card access

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Cliff Tam, a recent graduate from the University of Nevada, Reno, joins PanaVise Products, Reno, NV, as associate products manager.

Matt Moseley of the Atlanta Fire Department, Squad 4, wins the 1999 International Benjamin Franklin Fire Service Award for Valor, sponsored by Motorola, Schaumburg, IL, and the International Association of Fire Chiefs. Moseley demonstrated courage during the helicopter-assisted rescue of **Ivers Sims**, who was stranded on a construction crane 250 feet above the seven-alarm fire at the Fulton Bag & Cotton Mill in Atlanta on April 12.

Sammy A. Miles, former president of SigNet Paging, Raleigh, NC, joins In-Touch Management Systems, Melville, NY, as director of sales and marketing.

Changes at Glenayre Technologies, Charlotte, NC:

The company's three operating units, Wireless Messaging, Wireless Access and Integrated Networks, have been consolidated into the following business unit: **Warren Neuburger**, executive vice president of products, previously the head of the Integrated Networks Group, now manages the consolidated product management, engineering and customer service functions. **Bill Edwards**, who previously managed Integrated Networks' sales, becomes senior vice president of worldwide sales. **John Rottenburg**, senior vice president of operations, has responsibility for manufacturing and logistics. **Gary Hermansen**, previously head of Wireless Access, becomes senior vice president and general manager of the consumer products business unit. **Stan Ciepielinski**, previously chief operating officer, resumes that position.

Ian Maxwell leaves CommSite International, Vienna, VA, as vice president, site acquisition, to join SiteSafe, Arlington, VA, as vice president of operations.

Don Jones departs IBM as director of public sector industry marketing to join Tellabs, Lisle, IL, as vice president of North American sales.

Andy Merrill leaves Motorola as field engineering manager for the Western region, headquartered in Carlsbad, CA, to join Metawave Communications, Redmond, WA, as vice president, customer operations.

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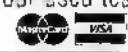
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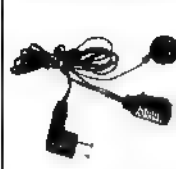
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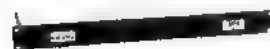
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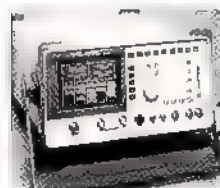
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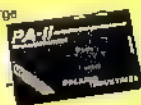
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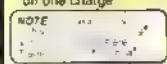
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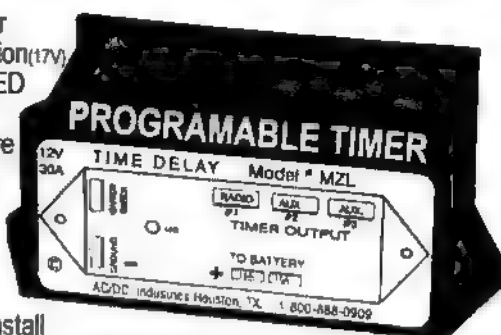
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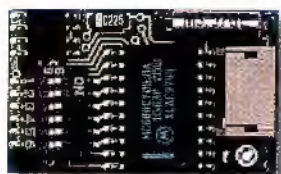


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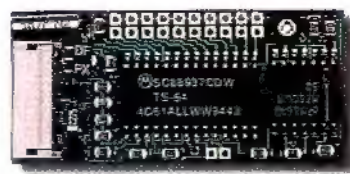
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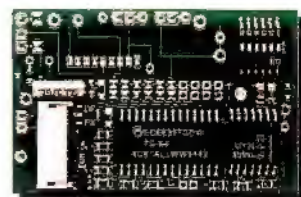
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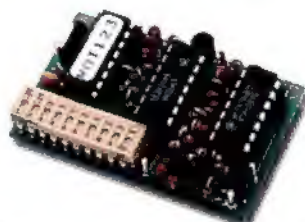
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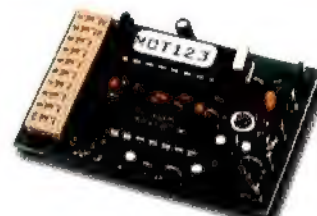
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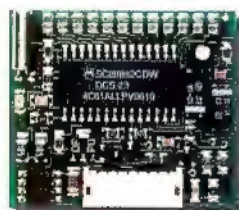
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